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February 20, 2013

U.S. Army Engineer District, Nashville
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Subject: ***Submittal of the Final Ash Pit No. 1 and Ash Pit No. 3 Site Characterization Report Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater***
Former Plum Brook Ordnance Works, Sandusky, Ohio
Contract No. W912QR-08-D-0013: Shaw Project Number 132457

Dear Ms. Coleman:

In accordance with the requirements of Delivery Order No. DX02 of Contract No. W912QR-08-D-0013, to Shaw Environmental & Infrastructure, Inc., a CB&I company, we are pleased to submit this Final Ash Pit No.1 and Ash Pit No. 3 Site Characterization Report Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater at the Former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio.

Enclosed are four copies of this draft report. Copies have also been sent to those on the distribution list, as indicated. As requested, the document was sent to the RAB in electronic format only.

Should you have any questions or require additional information regarding this submittal, please do not hesitate to contact me at (865) 694-7496.

Sincerely,

Steven T. Downey, PE, PMP
Project Manager

Enclosures

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Client Name: U.S. Army Engineer District, Nashville; CELRN-EC-E

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Final

Ash Pit No. 1 and Ash Pit No. 3
Site Characterization Report Addendum for
Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

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List of Acronyms

bgs	below ground surface
BHHRA	baseline human health risk assessment
BSC	background screening concentration
D&M	Dames and Moore, Inc.
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FUDS	Formerly Used Defense Sites
IDW	investigation-derived waste
mg/kg	milligrams per kilogram
NASA	National Aeronautics and Space Administration
OD	outside diameter
OEPA	Ohio Environmental Protection Agency
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
PCB	polychlorinated biphenyl
PETN	pentolite
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RBSC	risk-based screening concentration
SCR	site characterization report
Shaw	Shaw Environmental & Infrastructure, Inc.
SLERA	Screening Level Ecological Risk Assessment
SWSAP	site-wide sampling and analysis plan
SWSHP	site-wide safety and health plan
SVOC	semivolatile organic compound
TAL	target analyte list
TNT	trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B

List of Acronyms (continued)

TNTC	TNT Area C
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

Executive Summary

The U.S. Army Corps of Engineers is investigating the former Plum Brook Ordnance Works (PBOW) in Sandusky, Erie County, Ohio, under the Defense Environmental Restoration Program's Formerly Used Defense Sites authorization and funding. The PBOW site was used for the manufacture of explosives during World War II. The former PBOW site is currently operated and maintained by the National Aeronautics and Space Administration as Plum Brook Station, an active testing and research installation associated with the John H. Glenn Research Center of Cleveland, Ohio. The U.S. Army Corps of Engineers contracted Shaw Environmental & Infrastructure, Inc., a CB&I company, to conduct an addendum to the existing Ash Pit No. 1 and Ash Pit No. 3 site characterization report (SCR) documenting soil conditions of the Ash Pit No. 3 associated coal yard (Coal Yard No. 3). The specific investigation site is located immediately to the south of former Powerhouse No. 3, which is located in the central western part of PBOW.

During PBOW explosives manufacturing operations from 1941 to 1945, three power stations, Powerhouse No. 1, Powerhouse No. 2, and Powerhouse No. 3, were present to support the nitroaromatic manufacturing process. Each power station consisted of a main powerhouse, a coal storage area (coal yard), and two aboveground fuel storage tanks. Each power house building consisted of a boiler house, compressor room, electrical room, filter room, and locker room. The buildings also contained two to four large coal-burning boilers, a turboelectric generator, a feed water treatment system, and several steam-driven or electric air compressors. The generated steam was used for space heating, driving compressors, and generating electrical power. The coal yards were used as storage areas to provide coal for use in the powerhouse boilers. The coal was brought into the yards via train. All stockpiled coal has been removed, but the removal date is not known. Chemical contamination (increase of target analyte list [TAL] metal compounds) of the soil resulting from the leaching of precipitation through the coal stored in Coal Yard No. 3 is expected to be primarily semivolatile organic compounds (SVOC) and TAL metals, although nitroaromatics and volatile organic compounds (VOC) could be possible.

The SCR for Ash Pit No. 1 and Ash Pit No. 3 was submitted as a final report in November 2010. This addendum details remedial investigation activities for associated Coal Yard No. 3 and groundwater sampling for newly installed Ash Pit No. 3 monitoring wells; it also includes soil and groundwater sample collection, analytical results, and recommendations. This document is one of two planned reports. The remaining report will consist of a remedial investigation summary report and will be submitted under separate cover. The

remedial investigation summary report will include information from the Ash Pit No. 1 and Ash Pit No. 3 site characterization reports (including this addendum) as well as the baseline human health risk assessments and the screening level ecological risk assessments that have been prepared for each site.

No previous site-specific investigations at Coal Yard No. 3 have been conducted.

Remedial investigation activities were conducted by Shaw Environmental, Inc. for this Ash Pit No. 3, Coal Yard No. 3 SCR addendum in December 2011. Field activities for soils included hand auger operation with soil sampling, soil borehole lithologic logging, paperwork completion, surveying, and disposal of investigation-derived waste. Field activities for groundwater included monitoring well installation, groundwater sampling, and Snap Sampler™ installation and operation.

Four soil boring locations were chosen based upon ground surface coal thicknesses of the former coal yard area. Selected areas were chosen by scraping the surface with a pick-axe and measuring the coal thickness, if present. From each boring location, collection of soil samples was conducted from three distinct intervals to provide evidence of possible soil contamination as a result from leaching of precipitation through the former stockpiled coal. Surface soil samples were collected from the 0- to 1-foot depth interval where no coal was present. Where coal was present, the surface soil sample was collected as the 1-foot interval immediately below the coal layer. The second soil sample was collected from a depth below ground surface representing the 3- to 5-foot interval. The third sample was collected at a depth of 8 to 10 feet below the existing ground surface. Each soil sample from the selected interval was transferred to a new resealable plastic bag and homogenized. Soil was analyzed for nitroaromatics, SVOCs, and TAL metals. Soil from the 0- to 1- and 3- to 5-foot intervals was also analyzed for polychlorinated biphenyls. Hand auger drilling and soil sample collection were completed on December 19, 2011.

Three monitoring wells were installed at Ash Pit No. 3 in upgradient (AP3-MW01), source (AP3-MW02), and downgradient (AP3-MW03) locations with respect to the ash pit. Analytical results from the various media collected were compared to risk-based screening concentrations (RBSC) derived from November 2011 U.S. Environmental Protection Agency regional screening levels for a residential land-use scenario. These screening levels were used as points of comparison in this SCR addendum. In addition, the analytical results for the TAL metals in the 2011 soil samples were compared to soil background screening concentrations (BSC).

Significant conclusions from the surface and subsurface soil analytical results are as follows:

- No nitroaromatics or polychlorinated biphenyls were detected in the surface or subsurface soil samples.
- No SVOCs were detected in subsurface soil samples.
- Five SVOCs were detected above RBSC levels in two surface soil borings (CY3-SB01 and CY3-SB02), and one was above the RBSC in boring CY3-SB03.
- No TAL metals exceeded both the RBSC and BSC values in surface and subsurface soil samples.
- Total organic carbon was measured in the surface soil at a concentration of 0.66 milligrams per kilogram.

Significant conclusions from the groundwater analytical results are as follows:

- No VOCs or nitroaromatics were detected above RBSC levels in any of the samples.
- Arsenic, iron, and manganese exceeded both the BSCs and RBSCs in upgradient well AP3-MW01. These exceedances appear to be due to a localized change in groundwater geochemistry, possibly from leaching of organic matter from the Coal Yard No. 3 area.

Both the surface and subsurface soil at Coal Yard No. 3 appear to be unimpacted by the previous storage of coal for operation of Powerhouse No. 3. Analytical evidence provides no indication of increasing TAL metals concentrations (or decreasing concentrations) in subsurface soil as a possible result of precipitation leaching through stored coal. Coal Yard No. 3 soil as well as the RBSC and BSC exceedances by arsenic, iron, and manganese in the shallow groundwater at Ash Pit No. 3 will be evaluated by a revised BHHRA. Concluding evaluations and recommendations along with a summary of this investigation will be included in a remedial investigation report, submitted under separate cover.

1.0 Introduction

The U.S. Army is conducting studies of environmental impacts attributable to releases associated with historical operations of a property previously owned by the U.S. Department of Defense, the former Plum Brook Ordnance Works (PBOW) in Sandusky, Erie County, Ohio (Figure 1-1). PBOW is an Army Defense Environmental Restoration Program (DERP) project under the Great Lakes and Rivers Division Formerly Used Defense Sites program (FUDS). The Louisville District Office of the U.S. Army Corps of Engineers (USACE) is the program management district for the Great Lakes and Rivers Division Formerly Used Defense Sites program. Management support for PBOW is provided by the USACE Huntington District Office and technical oversight is provided by the USACE Nashville District Office. This 9,000-acre facility was used for the manufacture of explosives during World War II. The site is currently controlled and maintained by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station (PBS) of the John H. Glenn Research Center at Lewis Field.

Fieldwork and reporting for Ash Pit No. 3 Coal Yard (Coal Yard No. 3) was performed under Delivery Order DX02 for the USACE Louisville Architecture/Engineering Environmental Services Indefinite Delivery/Indefinite Quantity, Contract Number W912DR-08-D-0013. Fieldwork and reporting for Ash Pit No. 3 groundwater was performed under Delivery Order DX02 for the USACE Louisville Architecture/Engineering Environmental Services Indefinite Delivery/Indefinite Quantity, Contract Number W912DR-05-D-0026 (monitoring well installation and one round of groundwater sampling) and Delivery Order DX02 for the USACE Louisville Architecture/Engineering Environmental Services Indefinite Delivery/Indefinite Quantity, Contract Number W912DR-08-D-0013 (one round of groundwater sampling).

The field activities completed by Shaw Environmental & Infrastructure, Inc. (Shaw), a CB&I company, for investigation of Coal Yard No. 3 and Ash Pit No. 3 were conducted pursuant to the following documents:

- Site-Wide Accident Prevention Plan/Site-Wide Health and Safety Plan Appendix (SWSHP) (Shaw, 2008a)
- Site-Wide Sampling and Analysis Plan (SWSAP) (Shaw, 2008b)
- Site-Wide Quality Assurance Project Plan (QAPP) (Shaw, 2008c).

- Site-Specific Sampling and Analysis Plan, Data Gap Investigation at Powerhouse Ash Pit No. 3 (Shaw, 2011a).
- Site-Specific Sampling and Analysis Plan, Investigation of Coal Yards in the Areas of Ash Pit Nos. 1 & 3 and Powerhouse No. 2 Ash Pit, December 2011 (Shaw, 2011b).

1.1 Scope of Work and Project Objectives

The scope of this site characterization report (SCR) addendum (USACE, 2011) included updating the existing quality control plan, addition of site-specific addenda to the SWSHP and SWSAP, implementation of soil sampling, groundwater monitoring well installation and sampling, surveying, analytical work, and investigation-derived waste (IDW) management and disposal. Figure 1-2 identifies the locations of Ash Pit No. 3 and Coal Yard No. 3 in relation to other areas of concern and site features.

The objectives of this investigation to address data gaps in soil and groundwater samples include the following:

- Conduct soil sampling and lithologic logging
- Conduct groundwater monitoring well installation and associated groundwater sampling
- Conduct laboratory analysis of soil and groundwater samples
- Manage and dispose of IDW
- Submit an SCR addendum
- Update the baseline human health risk assessment (BHHRA) and screening level ecological risk assessment (SLERA)
- Prepare and submit a geographic information system deliverable.

This document is one of two planned reports. The remaining report will be the remedial investigation report that will summarize the findings of the following documents:

- Ash Pit No. 1
  - Coal Yard No. 1 SCR Addendum
  - Ash Pit No. 1 SCR

  - Ash Pit No. 1 BHHRA
  - Ash Pit No. 1 SLERA

- Ash Pit No. 3
  - Coal Yard No. 3 SCR Addendum for Soil and Ash Pit No. 3 for Groundwater
  - Ash Pit No. 3 SCR
  - Ash Pit No. 3 BHHRA
  - Ash Pit No. 3 SLERA

The remedial investigation report is planned to be issued in 2013.

1.2 Report Organization

Chapter 2.0 of this report describes PBOW and the Coal Yard No. 3 site, its physical setting, geology, and hydrogeology features. Sampling strategy and field procedures are described in Chapter 3.0. The analytical program and background comparison data are presented in Chapter 4.0. Chapter 5.0 describes specific-site information and historical and current analytical data. Chapter 6.0 presents media conclusions. Recommendations are provided in Chapter 7.0. References that were used in preparing the report are listed in Chapter 8.0.

Sample collection logs, soil boring logs, well development logs and photographs, and land survey data are provided in Appendices A, B, C, and D respectively. An IDW manifest is included in Appendix E. Appendices F through I contain analytical data pertinent to the soil sampling event. Appendix J presents the chains of custody for laboratory analysis. Appendix K presents monitoring reports for the active bald eagle nest near the Ash Pit 3 groundwater wells.

1.3 Facility Location and Description

The former PBOW site is currently utilized and maintained by NASA and is operated as the PBS, a satellite office of the NASA John H. Glenn Research Center, located at Lewis Field in Cleveland, Ohio. Most of the aerospace testing facilities built at the site in the 1960s are on standby or inactive status. The site is located approximately 4 miles south of Sandusky, Ohio, and 59 miles west of Cleveland. Although primarily in Perkins and Oxford Townships, the eastern edge of the site extends into Huron and Milan Townships. PBOW is bounded on the north by Bogart Road, on the south by Mason Road, on the west by Patten Tract Road, and on the east by U.S Highway 250. The areas surrounding PBOW are mostly agricultural and

residential (Figure 1-2). Public access is restricted at PBOW except during the annual deer hunting season.

1.4 PBOW Site History

The PBOW site was built in early 1941 and manufactured 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite (PETN). Production of explosives began in December 1941 and continued until 1945. During operation, three areas (TNT Area A [TNTA], TNT Area B [TNTB], and TNT Area C [TNTC]) manufactured TNT and DNT and one area manufactured PETN. TNTA consisted of manufacturing lines 1 through 4, TNTB consisted of lines 5 through 7, and TNTC consisted of lines 8 through 12. TNTA is located on the northeast side of PBOW, TNTB is located at the southern-central part, and TNTC is located at the southwestern side of PBOW. The PETN manufacturing area is located in the north-central portion of PBOW and lies within the boundaries of Ransom Road on the west, Pentolite Road on the south, and Patrol Road on the north and east. The central portion of the former PETN manufacturing area was formerly occupied by NASA's inactive nuclear reactor, which was decommissioned in 2012 with all aboveground structures demolished and removed from the site.

It is estimated that more than one billion pounds of explosives were manufactured during the 4-year operating period. After the plant was shut down, decontamination of TNT, acid, PETN, and DNT processing lines began. Decontamination was considered complete during the last quarter of 1945. The property was initially transferred to the Ordnance Department after it was certified by the Army to be decontaminated in 1946. This transfer did not include the 2,800 acres comprising the Plum Brook Depot area, also known as the magazine area. The War Assets Administration accepted custody of the remaining acreage (approximately 3,230 acres) in 1946. The Department of the Army reacquired the 3,230 acres in 1954 and performed cleanup efforts during the 1950s through 1963.

Two property use agreements were entered into by the National Advisory Committee of Aeronautics, the predecessor of NASA, and the Army in 1956 and 1958. On March 15, 1963, accountability for and custody of the entire PBOW property (6,030 acres) was transferred to NASA by the Department of the Army. NASA performed further decontamination during 1964. The NASA decontamination process was accomplished in five steps (Dames and Moore, Inc., 1997a):

1. Inspecting and removing contaminated surface soil above the drain tiles, flumes, etc.

2. Spot checking of subsurface soil in the vicinity of drain tiles, flumes, etc., to determine where the contaminated tiles and flumes were located. Where contamination was found, the flumes, tiles, etc., were removed in sections.

3. Removal of some items previously decontaminated to Level 3X (XXX-military decontamination level established primarily for worker safety that indicates potentially contaminated material or previously contaminated material that has been decontaminated to a zero residual contamination level) condition to a storage facility and additional decontamination of the remainder of the items to a 5X (XXXXX – level that indicates a decontaminated material with no detectable residual contamination) condition in order to be sold ("X" indicates the Army's specific decontamination level).

4. Destruction of all buildings by fire followed by removal of all debris and concrete foundations. All the materials, including the earth, in those areas were flashed and the area was then rough graded.

5. Decontamination of all sump basins and removal of the concrete.

The decontamination process also included burning of nitroaromatic-filled flumes that were excavated. As shown in the records review (Dames and Moore, Inc., 1997b), this was performed on July 10, 1963, near the intersection of Fox Road and Snake Road and is suspected to have also occurred at the Additional Burning Ground area.

On April 18, 1978, NASA declared approximately 2,152 acres of land as excess. This excess acreage included former buffer areas that were not formerly used by the Army and were not subject to decontamination efforts. The Perkins Township Board of Education acquired 46 acres of the excess for use as a bus transportation center. The General Services Administration retains the remaining acreage and currently has a use agreement with the Ohio National Guard for 604 acres of the land. NASA controls about 6,400 acres and is using the site to conduct space research as a satellite operation of the John H. Glenn Research Center based in Cleveland, Ohio. The details of these land transactions are listed in the site management plan (International Consultants Incorporated, 1995) and can be found at NASA PBS.

1.5 Coal Yard No. 3 Site History

As noted in Section 1.4, PBOW was built in early 1941 and manufactured acid, 2,4,6-TNT, DNT, and PETN until 1945. Three power stations, Powerhouse No. 1, Powerhouse No. 2, and Powerhouse No. 3, were constructed and utilized to support the manufacturing processes. Each power station consisted of a main powerhouse, a coal storage area (coal yard), and two

aboveground fuel storage tanks. The fuel storage tanks were surrounded by a berm to contain any potential spills or leaks. Each power house building consisted of a boiler house, compressor room, electrical room, filter room, and locker room. Each building also contained two to four large coal-burning boilers, a turboelectric generator, a feed water treatment system, and several steam-driven or electric air compressors. The generated steam was used for space heating, driving compressors, and generating electrical power. The coal yards were storage areas providing coal to be used in the powerhouse's boilers. The coal was brought into the yards via train. Figure 1-2 shows the location of Coal Yard No. 3 on PBOW property.

Former Coal Yard No. 3 is located immediately to the south of Powerhouse No. 3. The historical former coal yard is estimated to have had been approximately 200 feet wide by 210 feet in length, covering approximately 1 acre. Figure 1-3 shows a historical photograph of the coal yard along with the associated powerhouse and two aboveground fuel oil storage tanks. The majority of the coal was removed from the site with only minor amounts of residual coal still present in the shallow subsurface. The coal removal date is unknown. Most of the area is currently covered with grass; however, approximately one-half of the western side of the former coal yard is covered with gravel. Since acquisition of PBOW property by NASA in 1963, former Powerhouse No. 3 has been used for different purposes. NASA has scheduled Powerhouse No. 3 for demolition in 2012 or 2013.

No environmental investigation of Coal Yard No. 3 has ever been conducted.

1.6 Ash Pit No. 3 Site History

Ash Pit No. 3 is located approximately 800 feet southwest of the intersection of Maintenance Road and Ransom Road, is west of the former NASA K-Site Test Facility research building (former Power House 3). The historical Ash Pit No. 3 was approximately 230 feet wide by 330 feet in length, covering approximately 1.7 acres. Operations at the K-Site Test Facility were officially abandoned in 2007 and the site is scheduled for demolition. Abandoned railroad tracks running in a north-south direction are located immediately east of Ash Pit No. 3. The pit is surrounded by thick vegetation, with mature and smaller trees. Water was discharged from the former pond by means of an east-west-trending drainage ditch that eventually discharges into Pipe Creek (USACE, 2000). Figure 1-2 shows the location of Ash Pit No. 3 on PBOW property

A review of aerial photographs indicates a lack of open water at Ash Pit No. 3 in recent history. NASA (2008) personnel stated that no water was present in Ash Pit No. 3 on July 22, 2008

(NASA, 2008). This was also the case during a September 2008 site visit by USACE and Shaw personnel, although a small ponded area was observed after a rain event during an October 2008 site visit. During the initial fieldwork conducted in May 2009 (spring), no surface water was present. However, by the fall of 2009, Ash Pit No. 3 was inundated with surface water due to heavy precipitation. Soil, surface water, and sediment were sampled in 2009 (Shaw, 2010). Due to the presence of surface water, underground utilities, and sensitive ecological habitat (nesting bald eagles), monitoring wells were not installed during the 2009 phase of the investigation.

2.0 Physical Setting

As noted in Sections 1.5 and 1.6, Coal Yard No. 3 is located immediately adjacent to and south of Powerhouse No. 3, and Ash Pit No. 3 is located immediately west of Powerhouse No. 3. Figure 2-1 shows the specific site location and general site features with ground surface topography. Descriptions and information regarding the local geography, topography, surface drainage, regional and local geology and hydrogeology characteristics, and precipitation influence effects on local water levels has been prepared and is included in the final Ash Pit No. 1 and Ash Pit No. 3 SCR (Shaw, 2010). This section describes the current site conditions for Coal Yard No. 3 relative to this investigation.

The western half of the former coal yard is covered with crushed stone and had been used for parking and NASA testing operations. The eastern half is a grassy area. During a site visit performed on September 1, 2011, the former Coal Yard No. 3 was observed to be covered by an old field that appeared to be mowed and maintained, but not on a routine schedule. The ground surface is fairly level, with gentle downward grades to the west and east. Surface water runoff, therefore, drains gently from Former Coal Yard No. 3 both to the west into Ash Pit No. 3 and to the east into a drainage ditch that runs parallel to Ransom Road (Figure 2-1).

3.0 Field Activities

3.1 Introduction

Field activities at Coal Yard No. 3 and Ash Pit No. 3 were performed in accordance with the updated and revised SWSAP (Shaw, 2008b) and site-specific work plans (Shaw, 2011a,b), as noted in Chapter 1.0. Activities included hand auger operation with soil sampling, soil borehole logging, documentation of fieldwork activities (sample collection logs, field activity daily logs, etc.), groundwater monitoring well installation, surveying, and disposal of IDW.

Prior to any intrusive work, a NASA-authorized dig permit was obtained for Coal Yard No. 3. The dig permit process included review of utility maps for any underground utilities, including storm water, sewer, electrical, natural gas, telephone, cable, or fiber optic lines in the area.

3.2 Soil Sampling

Prior to soil sampling, a pick-axe was used to dig at selected locations throughout the former coal yard area to determine the presence/absence and thickness of the coal layer throughout the site. This information was used to optimize placement for the soil borings and to verify the extent of the former coal yard. Based on visual observations from this activity, soil boring locations were chosen based on the interpreted extent of the former coal yard. Four soil borings (CY3-SB01, CY3-SB02, CY3-SB03, and CY3-SB04) were drilled at Coal Yard No. 3 using either a 2-inch or 3-inch stainless-steel hand auger. Soil was collected from a planned sample interval, transferred to a new, resealable storage bag, thoroughly homogenized, and sample bottles filled. All hand drilling activities were conducted by Shaw personnel on December 19, 2011. Figure 2-1 shows the location of the soil boring.

Three soil samples were collected from each soil boring from approximate depths of 0 to 1, 3 to 5, and 8 to 10 feet below ground surface (bgs) and analyzed for nitroaromatics, semivolatile organic compounds (SVOC), and target analyte list (TAL) metals. Also, the 0 to 1- and 3 to 5-foot soil samples were analyzed for polychlorinated biphenyls (PCB). One surface soil sample (0.2- to 1.2-foot interval from boring CY3-SB01) was analyzed for total organic carbon (TOC). Table 3-1 presents a summary of soil samples collected, and soil sample collection logs are included in Appendix A. Continuous lithologic logs were recorded for all soil borings during the drilling. Hazardous, toxic, and radiological waste drilling logs for each borehole are included in Appendix B.

Each borehole was abandoned after all soil sampling activities at Coal Yard No. 3 were complete. Bentonite granules were used to fill the 10-foot-deep borehole and brought to a depth of approximately 3 feet bgs. Remaining borehole soil from initial hand auger operations was placed into the borehole portion and brought to ground surface.

3.3 Monitoring Well Installation

Temporary groundwater piezometers planned for the 2009 Ash Pit No. 3 investigation could not be installed due to potential damage to sensitive ecological habitat associated with nearby nesting bald eagles. In addition, although two locations for piezometers were identified that would not have appreciably damaged any habitat, the presence of underground fiber optic lines and water lines prevented their completion in these areas. Because the locations for new monitoring wells is based on the groundwater flow direction determined from the temporary piezometers, monitoring well locations could not adequately be determined. However, after completion of the groundwater investigation for Waste Water Treatment Plant No. 3, located immediately north of Ash Pit No. 3, the generalized groundwater flow direction in this area was determined (Shaw, 2012). The general flow direction in the Waste Water Treatment Plant No. 3 area was to the northwest during the May 2009 wet season, and southeast during the November 2009 dry season measurements. This reversal of flow direction is interpreted to be the result of the influence of groundwater discharge to surface ditches. During August 2011, Shaw installed three overburden/shale monitoring wells (AP3-MW01, AP3-MW02, and AP3-MW03). The well installation coincided with the time period that would have the least impact on the bald eagles (i.e., August through December) because they are not actively nesting.

A total of three 2-inch overburden monitoring wells were installed as part of the remedial investigation at Ash Pit No. 3 (AP3-MW01, AP3-MW02, and AP3-MW03). Monitoring wells were installed in upgradient, downgradient, and suspected source area locations based on the interpreted groundwater flow directions observed at Waste Water Treatment Plant No. 3, which is located immediately north of Ash Pit No. 3.

Monitoring wells were installed in accordance with guidelines specified in USACE Engineering Manual EM-1110-1-4000 (USACE, 1998) and following the procedures in the SWSAP (Shaw, 2008b). All monitoring wells were completed as described below.
Monitoring well installation was conducted August 16 and 17, 2011 by M&W Drilling, LLC of Knoxville, Tennessee. Prior to drilling, dig permits for direct-push drilling, already in place with NASA, were reviewed to ensure no underground utilities would be encountered during drilling at

monitoring-well borehole locations. In addition, the first 5 feet at each borehole location were manually dug with a 4-inch outside diameter (OD), decontaminated, stainless-steel posthole digger to confirm no utilities were overlooked or not identified by NASA utility location diagrams.

Following posthole digging to 5 feet, soil boreholes were advanced by a Geoprobe 7730DT drill rig using 8.5-inch OD (4.25-inch inside diameter) hollow-stem augers to the depth of auger refusal. Soil samples were continuously collected from the ground surface to terminating depth using a 2.25-inch OD core barrel with acetate liner. Soil core samples were visually examined by a Shaw field geologist and documented on hazardous, toxic, and radiological waste drilling logs. Overburden/shale monitoring well construction logs are included in Appendix B. Well completion in each borehole was accomplished using 2-inch diameter polyvinyl chloride Schedule 40 riser pipe and a 10-foot Schedule 40, polyvinyl chloride section of 0.010-inch factory slotted screen. No soil samples were submitted to an analytical laboratory, but each sample was screened by a Sirius air quality meter to measure any organic vapors. Monitoring well details are shown in Table 3-2. Construction logs of the monitoring well associated with the appropriate borehole are also included in Appendix B.

3.4 Monitoring Well Development

All newly constructed monitoring wells were developed no sooner than 48 hours and no later than 7 days after completion of well construction. A Waterra pump connected with a 1-inch check valve and ½-inch inside diameter high-density polyethelyene tubing was used to perform well development. The Waterra pump is an inertial pump that requires a 6- to 8-inch surging action for water removal. During development, the check valve and associated tubing were repositioned vertically throughout the screened interval to fully develop the entire well screen. Periodically, development was further enhanced by removing the tubing from the pump and conducting a more aggressive, manual, 1-to-2-foot length surging action. A well development log was completed for each well to document well development progress, field parameters, and other pertinent information. Photographs of development water and well development logs are included in Appendix C.

3.5 Groundwater Sampling

The initial groundwater sampling event using low flow sampling methods was completed at Ash Pit No. 3 in December 2011. As previously noted, the August through December time period has minimal impact to the eagles because this is outside of the nesting period. A special protocol was

established to minimize disturbance to this nesting pair and their young during the May 2012 sample collection period. The protocol included the use of Snap Samplers™ to collect groundwater samples as well as a wildlife ecologist onsite observing the eagles' behavior during sampling. A Snap Sampler is a passive, no-purge groundwater sampling system which seals groundwater samples in situ upon collection. This system provides representative groundwater samples from within a well and allows the rapid collection of the sample using minimal site personnel thereby minimizing disturbance to the nesting eagles nearby. Two phases are necessary for groundwater sampling using Snap Samplers: device insertion and removal/collection of the groundwater sample. Based on conversations with the manufacturer, the proper deployment time (i.e., the time between insertion and removal) may vary from a few days to several months, with a minimum recommended deployment time of 3 days. The actual deployment time in this study was approximately one month.

3.5.1 Low-Flow Groundwater Sampling

One low-flow groundwater sampling event was completed at Ash Pit No. 3 in December 2011. Groundwater from the monitoring wells was low-flow sampled using a bladder pump. Groundwater samples were analyzed for nitroaromatics, metals (filtered and unfiltered), volatile organic compounds (VOC), SVOCs, and water quality parameters (alkalinity, chloride, cyanide, hardness, nitrate/nitrite, sulfate, total dissolved solids, total suspended solids, turbidity, ferrous iron, and oxidation-reduction potential).

To assess the potential breathing air quality at a well prior to purging activities, the lid to the well was removed upon arrival and vapors within the casing were immediately measured using a Sirius air quality meter that measures organic vapors, lower explosive limit, carbon dioxide, oxygen, and hydrogen sulfide content. Once well purging activities commenced, breathing air concentrations were continuously measured and compared with the health and safety requirements (Shaw, 2008a). Hydrogen sulfide readings did not pose a problem at Ash Pit No. 3 during either groundwater sampling event.

Samples collected for total dissolved metals analysis were filtered in the field through a 0.45-micron, high-capacity filter attached to the discharge line of the bladder pump. All groundwater that was removed from the wells during purging activities was containerized and properly disposed of following the IDW management procedures specified in the Shaw SWSAP (Shaw, 2008b) and work plan (Shaw 2009). Details of disposal activities are presented in Section 3.8.

Table 3-1 shows a list of the primary groundwater samples collected. Final field measurements were recorded immediately before the water quality meter flow-through cell was disconnected which was immediately prior to collection of the groundwater sample (Table 3-3). Monitoring well locations are shown on Figure 2-1. Appendix A contains groundwater sample collection logs.

3.5.2 Snap Sampler Groundwater Sampling

During April 2012, a sampling team inserted Snap Samplers into each of the three Ash Pit No. 3 groundwater monitoring wells in order to complete sampling activities without disturbing the bald eagles nesting near the site. A Snap Sampler™ was also deployed at an Ash Pit No. 1 well, AP1-MW01, to use as a comparison test case. Prior to retrieving the Snap Samplers at Ash Pit No. 3, the Ash Pit No. 1 sampler was retrieved in order to familiarize the sampling team with how to operate the sampler closing mechanism, retrieve the sampler from the borehole, and process the samples in such a way as would minimize disturbance to the eagles at Ash Pit No. 3. A traditional low-flow sample was also collected prior to removing the Snap Sampler at AP1-MW01 to compare to the data obtained from the Snap Sampler. The samples from AP1-MW01 were analyzed for metals only because no other analytes had been detected in that well during previous sampling. The Snap Samplers were removed during the last week of May 2012 and their contents analyzed following the usual analytical protocols. The major drawbacks to the Snap Samplers are the limited sample volume that can be obtained, particularly from smaller-diameter (2-inch) wells, and the fact that field data (pH, oxidation-reduction potential, turbidity, etc.) cannot be obtained since this is a no-purge procedure. Because of low volumes, the full suite of analyses could not be performed on the Ash Pit No. 3 groundwater samples. Based on the analytical results from samples collected in December 2011 by standard low-flow sampling, the samples collected in May 2012 were analyzed for VOCs, metals, and nitroaromatics. Note that some of the analyses that were performed had elevated detection limits (nitroaromatics only due to limited sample volume), but that the elevated detection limits are still sufficiently low to achieve the data quality objectives (DQO) set for the site.

Monitoring of the bald eagles' nest during Snap Sampler deployment and retrieval at Ash Pit No. 3 was conducted by a wildlife ecologist to document eagle behavior and response. The detailed reports for the eagle monitoring activity are presented in Appendix K.

3.6 Decontamination Procedures

Decontamination of the hand auger and other sampling equipment was performed in accordance with Section 5.0 of the SWSAP (Shaw, 2008b). Sampling equipment was decontaminated by rinsing in sequence with phosphate-free soapy water, tap water, nitric acid, methanol, hexane, and deionized water. Equipment was then air dried, if possible, before use. The bucket augers were decontaminated prior to each boring. The low flow groundwater sampling and Snap Samplers used dedicated equipment and no decontamination was needed.

3.7 Land Survey

In early November 2011, an Ohio-registered professional land surveyor surveyed the soil and monitoring well boring locations (including proposed boring locations). Horizontal coordinates were surveyed to the closest 0.1 foot and referenced to the Ohio State Plane Coordinate System. The land surface elevation was surveyed to the nearest 0.01 foot and referenced to the 1929 National Geodetic Vertical Datum. Land survey data reports are included in Appendix D.

3.8 Investigation-Derived Waste Management

IDW generated during investigation activities included soil, groundwater, decontamination water, and personal protective equipment. All IDW was managed and handled in accordance with procedures described in the SWSAP (Shaw, 2008b).

All decontamination fluids generated during field activities, except the nitric acid, methanol, and hexane rinse, were stored in a labeled 55-gallon drum. The nitric acid, methanol, and hexane rinse fluids were collected in a stainless-steel pan and evaporated. Drummed decontamination fluid was sampled to determine if it should be classified as a hazardous or nonhazardous material as well as soil generated during installation of the shallow monitoring well at Ash Pit No. 3. Soil generated during hand auger operations was placed back into the borehole. Personal protective equipment (Tyvek® suits, latex gloves, etc.) and general refuse were double bagged and disposed in an on-site, Shaw-contracted industrial dumpster.

On October 18, 2011, after soil cuttings and groundwater were determined nonhazardous, these materials were transported to a registered disposal facility (Environmental Quality Company) in Detroit, Michigan, for disposal Following analytical determination that the waste water was nonhazardous, on January 26, 2012 and June 25, 2012, the IDW water was transported by Triad Transport, Inc. to the Environmental Quality Company in Detroit, Michigan, for disposal. The waste manifests for disposal of are shown in Appendix E.

4.0 Analytical Program

The following sections present the analytical program used in this investigation. This review includes the laboratories used for all samples, the analytical methods used, data quality evaluation, and blank analysis. In addition, a description and derivation of risk-based screening concentrations (RBSC) is presented in Section 4.2.1. The derivation and use of background screening concentrations (BSC) and the analytical results are presented in Section 4.2.2.

4.1 Analytical Program and Methodologies

4.1.1 Sample Analysis and Data Validation

Primary and quality control (QC) project samples collected in December 2011 were analyzed by Accutest Laboratories of Orlando, Florida (QC samples are also referred to as field duplicate samples). Quality assurance (QA) samples were analyzed by Test America, Inc. of North Canton, Ohio (QA samples are also referred to as field split samples). Analysis for nitroaromatic field split samples was performed by Test America of Sacramento, California. Shaw performed the data validation. The validation summaries are provided in Appendix F. The analytical results are summarized in Appendix G. Tables of detected hits data are included in Appendix H. A data quality evaluation is included in Appendix I.

All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following the guidelines in the U.S. Environmental Protection Agency (EPA) *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008) and EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004), the QAPP (Shaw, 2008c), and specific analytical method requirements. Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness, and comparability goals established to meet the project DQOs. The criteria for blank evaluation were based on those detailed in *Region 3 Modifications to National Functional Guidelines for Evaluating Organic Analyses* (EPA, 1994) and *Region 3 Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993).

4.1.2 Analytical Methods

Chemical analyses for the investigation were performed in accordance with guidelines detailed in EPA's *Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods* (EPA, 1986) and subsequent revisions. The soil samples and associated QA/QC samples were analyzed for PCBs, SVOCs, nitroaromatics, and TAL metals. Groundwater samples and associated QA/QC samples were analyzed for VOCs, SVOCs, nitroaromatics, metals (filtered and unfiltered samples), and water quality parameters. Methods used for analysis are summarized in Table 4-1.

4.1.3 Data Quality Evaluation

The reliability of the sampling and analytical procedures used during the investigation was demonstrated by implementing the project-specific QA procedures specified in the SWSAP (Shaw, 2008b) and in the QAPP (Shaw, 2008c) and its site-specific attachments. Successful execution of these procedures provides strong supporting evidence that the data are representative of the areas under investigation.

The DQOs for this project were to produce scientifically valid data of known accuracy and precision that were complete with respect to identified critical samples, comparable with similar data types, and representative of the media sampled so as to be useful for the cited purposes. Evaluation of the data using the DQOs and the data validation process resulted in the determination that the data set is valid and of sufficient quality to meet the objectives of the investigation.

A complete evaluation of the analytical results is given in the data quality evaluation in Appendix I.

4.1.4 Blank Evaluation

The purpose of blank analysis is to detect contamination resulting from laboratory and field activities. For this site, field blanks were not required. Only laboratory method blanks were analyzed. Blank evaluation involves qualification of data based on the results of the laboratory method blanks. The criteria for blank evaluation are as follows:

- If a parameter is found in a blank but not detected in the sample, no action is taken.
- For organics, if the sample result is less than 5 times (most analytes) or 10 times (common laboratory contaminants) that of the blank result, the sample result is qualified "B."

- For TAL metals, if the sample result is greater than the instrument detection limit but less than 5 times the blank result, the sample result is qualified "B."
- If the sample result is greater than 5 times (most analytes) or 10 times (common laboratory contaminants) the blank result, no action is taken.

In instances where more than one blank is associated with a given sample, qualification is based upon a comparison with the associated blank having the highest concentration of a contaminant. Blank results are not subtracted from sample concentrations. Note that data with “B” validation qualifiers are included in the Chapter 5.0 tables, but the associated concentrations are not included in the tables’ “maximum detected concentration” column because “B”-qualified data are not regarded as detected and are not used in PBOW risk assessments.

4.2 Comparison to Screening Criteria

The analytical result tables presented in Chapter 5.0 include comparisons to RBSCs and BSCs as points of reference only. Concentrations of analytes that exceed the RBSCs are highlighted in the tables. RBSCs do not imply a regulatory limit or mandated cleanup level, nor is the identification of an exceedance intended to indicate an unacceptable human health risk or a need for remedial action. Formal evaluation of human health risks will be performed in the baseline human health risk assessment (BHHRA). Concentrations in individual samples that exceed the respective BSCs are presented in bold print in the Chapter 5.0 result table.

4.2.1 Risk-Based Screening Concentrations

The RBSCs are derived from April 2012 regional screening levels (EPA, 2012) using the methodology described in the Ash Pit No. 3 BHHRA work plan (Shaw, 2012). Soil and groundwater monitoring well samples were collected. Because the area surrounding PBOW is agricultural and residential and because other PBOW sites have been remediated based on unrestricted land use, risk-based screening has been performed based on residential exposure. This assumption is appropriate because the area surrounding the former PBOW facility is rural and residential, and if and when the property is accessed, the land will likely become residential. The groundwater RBSCs are based on a generalized residential drinking water scenario, assumed to be the most restrictive use of groundwater, and correspond to a one-in-a-million (1E-6) incremental lifetime cancer risk or a noncancer hazard quotient of 0.1, whichever results in a lower concentration (Shaw, 2012). The soil RBSCs are based on a long-term residential land-use scenario that assumes use by a young child for noncancer effects and use by the combined young

child and adult life stages for carcinogenic effects. Together, these capture a plausible case for future land use. The soil RBSCs are based on an incremental lifetime cancer risk of 1E-6 and a hazard quotient of 0.1. As stated in Section 4.2, laboratory analytical results are compared to RBSCs only as a point of reference. Further details on the RBSCs and their derivation are provided in the BHHRA work plan.

4.2.2 Background Screening Concentrations

BSCs have been derived for metal analytes and benzene, toluene, ethylbenzene, and xylene in groundwater (Shaw, 2005) and for metals in soils (IT, 1998). Table 4-2 presents a complete list for metals in soil, while Table 4-3 presents a complete list for metals in groundwater. The BSCs were derived from concentrations of these analytes found in PBOW background groundwater monitoring wells and soil data sets. The background soil samples were collected from near the property boundary, away from any potential source areas, and the background groundwater wells were installed in off-site areas upgradient of PBOW sources. Each BSC is the calculated 95th percent upper tolerance limit or the maximum detected concentration of the background data set, whichever value is lower, for each relevant analyte (IT, 1998; Shaw, 2005). The background monitoring well samples were collected using low-flow methodology and were not filtered. It is noted that the method agreed upon for the development of BSCs by the Ohio Environmental Protection Agency (OEPA) and USACE, as recorded in the September 11, 2002 PBOW team meeting minutes, differs from that shown in current OEPA (2009) guidance. This PBOW team agreement, which has been used for all PBOW risk assessments to date, takes precedence over the subsequent OEPA (2009) guidance. This protocol ensures that all PBOW sites will be evaluated for background in a consistent manner.

5.0 Investigation Results

Three overburden/shale monitoring wells were installed on August 16 and 17, 2011, with groundwater samples collected from December 16 through 20, 2011, and on May 30, 2012. As previously noted, the December groundwater samples were collected using standard low-flow purging methods and the May 2012 groundwater samples were collected using Snap Samplers. On December 19, 2011, four soil borings (CY3-SB01, CY3-SB02, CY3-SB03, and CY3-SB04) were completed within Coal Yard No. 3. Soil samples were collected from 1-foot intervals between 0 to 2.5, 3 to 5, and 8 to 10 feet bgs, for a total of three soils samples from each soil boring.

5.1 Coal Yard No. 3

The following sections describe the findings from the Coal Yard No. 3 investigation.

5.1.1 Coal Yard No. 3 Site-Specific Soils

As noted in the Ash Pit No. 1 and Ash Pit No. 3 SCR site-specific soil section (Shaw, 2010), fill sand was used at the close of PBOW and following remediation tasks to cover concrete foundations and demolition scars and to promote a natural landscape appearance. A soil that is interpreted to be possible fill or disturbed soil was encountered in soil borings CY3-SB01 and CY3-SB02. The surface soil is composed of dark brown and gray silt, coal, and sand overlying a silt, sand, and gravel mixture to depths of 1.2 feet bgs (CY3-SB01) and 1.5 feet bgs (CY3-SB02). The apparent fill or disturbed surface soil at these two locations is suspected to be a result of grading and mixing of the coal and surface soil. In CY3-SB03, no coal was encountered and the surface soil consists of silt with sand and clay. In boring CY3-SB04, the surface soil was dark grayish-brown silt with clay. Figure 2-1 shows a Coal Yard No. 3 site map with soil boring locations.

Below the possible fill and coal material at locations CY3-SB01 and CY3-SB02 and below surface soil in borings CY3-SB03 and CY3-SB04, native material consisted of glacial till, glacial outwash, or possibly a glacial lacustrine (lake) deposit. In general, the soil borings encountered silt with varying amounts of clay and/or sand that was medium-stiff in consistency with varying brownish hues to boring termination. In CY3-SB04, grayish-brown clay was encountered at a depth of 9 feet bgs. Groundwater was encountered at Coal Yard No. 3 at an average depth of 3 feet, as noted in the December 2011 borings.

The upgradient monitoring well for Ash Pit No. 3 (AP3-MW01) was completed in the western portion of Coal Yard No. 3. The subsurface soils are similar to that of boring CY3-SB04, with very dark brown to grayish-brown silt observed in the upper 16 feet of the boring. Below this depth, the soil consisted of dark gray clay.

5.1.2 Coal Yard No. 3 Soil Analytical Results

A total of 14 soil samples were collected from the four borings. Surface soil samples were collected at depths of 0.2 to 1.2 feet bgs (CY3-SB01), 1.5 to 2.5 feet bgs (CY3-SB02), and 0 to 1 foot bgs (CY3-SB03 and CY3-SB04). Ten subsurface soil samples (which include one QC and one QA sample) were collected from depth intervals of 3 to 5 and 8 to 10 feet. Soil samples were analyzed for nitroaromatics, SVOCs, and TAL metals. Also, the surface and 3- to 5-foot sample intervals were analyzed for PCBs, and one surface soil sample (0.2- to 1.2-foot interval from boring CY3-SB01) was analyzed for TOC. Table 5-1 summarizes the soil concentrations above RBSCs and/or BSCs. Figure 5-1 shows soil sample locations along with corresponding analytical results above RBSCs and/or BSCs.

5.1.2.1 Coal Yard No. 3 Surface Soil Samples

No nitroaromatics or PCBs were detected in any of the surface soil samples at Coal Yard No. 3. Fourteen SVOCs were detected in the four surface soil samples, and five SVOCs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) were above the respective RBSC screening levels. Detected concentrations of each of these five SVOCs exceeded the RBSCs in borings CY3-SB01 and CY3-SB02, while boring CY3-SB03 exhibited only benzo(a)pyrene above the RBSC. No SVOCs were detected in soil boring CY3-SB04.

No TAL metal analytical concentrations exceeded both the RBSC and BSC limits in surface soil samples at Coal Yard No. 3. TOC was measured in boring CY3-SB01 at a concentration of 0.66 milligrams per kilogram (mg/kg).

5.1.2.2 Coal Yard No. 3 Subsurface Soil Samples

No nitroaromatics, PCBs, or SVOCs were detected in the subsurface (3 to 5 and 8 to 10 feet) soil samples at Coal Yard No. 3.

No TAL metal analytical concentrations exceeded both the RBSC and BSC limits in the subsurface soil samples at Coal Yard No. 3.

5.2 Ash Pit No. 3 Groundwater

The following sections present the findings from the Ash Pit No. 3 groundwater investigation.

5.2.1 Ash Pit No. 3 Site-Specific Soils

The subsurface soils encountered in wells AP3-MW02 and AP3-MW03 are similar to those of Ash Pit No. 3 well AP3-MW01, previously described in Section 5.1.1, and Coal Yard No. 3 boring CY3-SB04. Surface soils in the upper 16 feet were observed to be very dark brown to grayish-brown silt. Below this depth, the soil consisted of dark gray clay.

5.2.2 Ash Pit No. 3 Site-Specific Hydrogeology

During August 2011 (dry season) groundwater monitoring well installation, overburden groundwater at Ash Pit No. 3 was encountered in all three of the well borings at depths ranging from 6.2 feet bgs (AP3-MW02 and -MW03) to 7.5 feet bgs (AP3-MW01). Overburden groundwater flow in the general vicinity of Ash Pit No. 3 varies. As can be seen on Figure 5-2, generated in October 2011, groundwater flow is generally to the northwest during periods of low recharge and lower groundwater elevations. However, when groundwater elevations reach an elevation of approximately 634 feet above mean sea level below the central portion of the ash pit, groundwater begins to discharge into the ash pit, which in turn is drained by a small ditch exiting the west side of ash pit. This groundwater discharge results in a localized reversal of groundwater flow to the southeast in AP3-MW03 (Figure 5-3).

5.2.3 Ash Pit No. 3 Groundwater Analytical Results

A total of eight groundwater samples (which includes one QC and one QA sample) were collected from the three overburden monitoring wells (Table 5-2). During the December 2011 sampling, which used low-flow purging and sampling, the samples were analyzed for VOCs, SVOCs, nitroaromatics, metals (filtered and unfiltered), and water quality parameters. During the May 2012 sampling, which used Snap Samplers, the samples were analyzed for VOCs, nitroaromatics, and filtered metals only.

No detections of VOCs or nitroaromatics exceeded RBSCs. Bis(2-ethylhexyl)phthalate, reported in only one sample at a concentration of 0.8 microgram per liter, is the only SVOC reported; however, this analytical result was qualified “B” during validation, and is regarded as a

laboratory artifact. Elevated concentrations of arsenic, iron, and manganese were detected in upgradient well AP3-MW01, although only manganese was detected above the RBSC in the results from both sampling events. Note that arsenic was not detected in the December 2011 groundwater samples. The concentrations of manganese were similar in both the filtered and unfiltered samples collected in December 2011, indicating manganese is present in groundwater in the dissolved phase and its presence cannot be attributable to suspended sediment. A filtered sample could not be collected from this well in May 2012 due to limited sample volume available from the Snap Sampler; however, the groundwater was visually clear. Also note that concentrations of manganese were similar in the December 2011 and May 2012 samples.

Review of the water quality data collected during the December 2011 sampling event suggests that the elevated concentrations of arsenic, iron, and manganese are due to a localized impact to the geochemistry of the overburden groundwater in the vicinity of AP3-MW01. The water quality data collected during sampling indicates the groundwater pH to be near neutral in all of the Ash Pit No. 3 wells. However, in AP3-MW01, the dissolved oxygen is approximately 1 milligram per liter. The other two wells at the site had dissolved oxygen concentrations greater than 5 milligrams per liter. This suggests that the Coal Yard No. 3 may have impacted groundwater potentially from the leaching of coal-related organics to the groundwater. A similar situation was observed in the Ash Pit No. 1 area, with dissolved oxygen being depressed immediately downgradient of Coal Yard No. 1.

5.2.4 Low-Flow versus Snap Sample Groundwater Sample Comparison

As noted in Section 3.5.2, groundwater samples were collected from three overburden/shale monitoring wells in Ash Pit No. 3 in December 2011 using low-flow groundwater sample collection methods. To prevent any disturbance to the nearby nesting eagles, groundwater samples were collected from the Ash Pit No. 3 wells using a Snap Sampler in May 2012. To determine if analytical results between the two groundwater sample collection methods could be biased based upon the method of collection, a Snap Sampler was also placed in overburden/shale monitoring well AP1-MW01. Before retrieval of the Snap Sampler from AP1-MW01, a groundwater sample was collected from the well using the low-flow sampling methodology. Groundwater samples from both methods of collection were analyzed for metals only. Table 5-3 presents analytical results of both sampling methods.

For an analytical comparison between the two groundwater sample results, a relative percent difference (RPD) of 30 percent was used. Between both sampling methods, a total of 14 total

recoverable metals were detected, 14 from low-flow sampling and 13 from the Snap Sampler. In most cases, analytical detections of metals using the low-flow sample collection method tended to be at a slightly higher concentration than the analytical metal detections of the Snap Sampler. When removing B qualified data (detected analytical data below the reporting limit), a total of five metal compounds (iron, magnesium, manganese, sodium, and calcium) are in common between the sampling methods. Reviewing the RPD of the five compounds, values greater than 30 percent may indicate some type of laboratory, field, validation, or other unknown error. Manganese was the only metal to show an RPD greater than 30 percent (calculated at a value of 62 percent). The analytical result of manganese from low-flow sampling was detected at a concentration of 16,100 ppb and at a concentration of 8,480 ppb by the Snap Sampler. Low-flow filtered and unfiltered analytical results were reviewed and manganese was detected in both samples indicating that it is present within the groundwater. The difference between the low-flow groundwater sample and Snap Sample groundwater result cannot be ascertained with absolute certainty from the available data; however it could be the result of the more limited vertical interval within the screened interval of the monitoring well sampled by low flow sampling. With a peristaltic pump, the “pump intake” is essentially the end of the submerged tubing and the vertical influence within the well screen from pumping at very low rates would be expected to be minimized. The Snap Sampler however, is a series of bottles submerged over a vertical interval of a larger length (approximately 4 feet in the case of AP1-MW01). Because of this greater vertical length, the groundwater sample represents more of a composite sample vertically in the monitoring well. In relatively homogenous settings, the difference in water quality vertically through the well screen may be minimal in a monitoring well. However, in stratified or highly variable geologic settings (such as the glacial sediments at PBOW), some variation may exist in water quality between individual stratified layers that could account for the differences seen in manganese concentrations.

With the exception of the manganese concentrations in well AP1-MW01, the analytical results from the Snap Sampler and the sample collected using the low-flow technology provided very similar results. Groundwater analytical results collected by using the Snap Sampler should be considered equal in confidence to that of the low-flow sample collection method.

6.0 Summary and Conclusions

6.1 Coal Yard No. 3

To determine possible contamination to soil caused by the storage of coal, four soil borings (CY3-SB01, CY3-SB02, CY3-SB03, and CY3-SB04) were completed within Coal Yard No. 3. To evaluate potential impacts of the Ash Pit No. 3 on groundwater, three overburden wells were installed and sampled.

Field activities at Coal Yard No. 3 were conducted in December 2011 and included hand auger operation, soil sample collection, lithologic logging, paperwork completion, and surveying. Disposal of IDW occurred in January 2012. A total of four surface and 10 subsurface soil (includes one QA and one QC sample) samples were collected. Surface soil samples were collected from depths of 0 to 1, 0.2 to 1.2, and 1.5 to 2.5 feet bgs (below an existing coal layer if present) and subsurface soil samples were collected from depths of 3 to 5 and 8 to 10 feet bgs. Soil samples were analyzed for nitroaromatics, SVOCs, and TAL metals. In addition, both the surface soil and 3- to 5-foot samples were analyzed for PCBs and one surface soil sample was analyzed for TOC. Analytical results obtained from each soil sample were screened against RBSC and BSC values. RBSC values do not infer a regulatory limit or mandated cleanup level, nor does an exceedance necessarily represent an unacceptable human health risk. They are used in this report only as points of reference.

Major findings from Coal Yard No. 3 soil sample results are summarized as follows:

- No nitroaromatics or PCBs were detected in the surface or subsurface soil samples.
- No SVOCs were detected in subsurface soil samples.
- Five SVOCs were detected above RBSC levels in two surface soil borings (CY3-SB01 and CY3-SB02) and one was above the RBSC in boring CY3-SB03.
- No TAL metals exceeded both the RBSC and BSC values in surface and subsurface soil samples.
- TOC was measured in the surface soil at a concentration of 0.66 mg/kg.

Both surface and subsurface soil appear to be unimpacted by the former storage of coal on the ground surface.

6.2 Ash Pit No. 3

To evaluate potential impacts of the Ash Pit No. 3 on groundwater, three overburden/shale wells were installed and sampled.

Field activities at Ash Pit No. 3 were conducted in August and December 2011 and May 2012. These activities included the installation, development, and sampling of three overburden monitoring wells. Disposal of IDW occurred in January and June 2012. A total of eight groundwater samples (which includes one QC and one QA sample) were collected from the three overburden monitoring wells (Table 5-2). During the December 2011 sampling, which used low-flow purging and sampling, the samples were analyzed for VOCs, SVOCs, nitroaromatics, metals (filtered and unfiltered), and water quality parameters. During the May 2012 sampling, which used Snap Samplers, the samples were analyzed for VOCs, nitroaromatics, and filtered metals only. Analytical results obtained from each groundwater sample were screened against RBSC and BSC values. RBSC values do not infer a regulatory limit or mandated cleanup level, nor does an exceedance necessarily represent an unacceptable human health risk. They are used in this report only as points of reference.

Major findings from Ash Pit No. 3 groundwater sample results are summarized as follows:

- No VOCs or nitroaromatics were detected above RBSC levels in any of the samples.
- Arsenic, iron, and manganese exceeded both the BSCs and RBSCs in upgradient well AP3-MW01. These exceedances are due to a localized change in groundwater geochemistry, possibly from leaching of organic matter from the Coal Yard No. 3 area.

7.0 Recommendations

The surface and subsurface soil of Coal Yard No. 3 appears to be adequately characterized. Only PAHs exceeded the RBSCs and none of the inorganics exceeded both the RBSC and BSC. Ecological hazards will be discussed in the remedial investigation report, which will state that, based on low concentrations of analytes in Coal Yard No. 3, no screening-level ecological risk assessment is required.

The groundwater associated with Ash Pit No. 3 is adequately characterized. The only analytes to exceed both RBSCs and BSCs in groundwater are arsenic, iron, and manganese in overburden well AP3-MW01, situated upgradient of Ash Pit No. 3 and downgradient of Coal Yard No. 3.

Planned Activities. A revised BHHRA for Ash Pit No. 3 that incorporates the results for groundwater will be completed, as will an addendum to the Ash Pit No. 3 BHHRA for Coal Yard No. 3 soil. In addition, a remedial investigation report that includes all of the investigation and evaluation associated with the Ash Pit No. 1 and Ash Pit No. 3 DERP-FUDS Project (No. G05OH001826) will be completed. All of the reports are anticipated to be completed in 2013.

8.0 References

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TABLES

Table 3-1

Summary of Soil and Groundwater Samples Collected
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Type	Sample Location	Sample Number	Sample Date	Sample Purpose	SDG Number
SS	CY3-SB01	CY0031	19-Dec-11	REG	F88938
DS	CY3-SB01	CY0032	19-Dec-11	REG	F88938
DS	CY3-SB01	CY0033	19-Dec-11	FD	F88938
DS	CY3-SB01	CY0034	19-Dec-11	FS	240-7168-1
DS	CY3-SB01	CY0035	19-Dec-11	REG	F88938
SS	CY3-SB02	CY0036	19-Dec-11	REG	F88938
DS	CY3-SB02	CY0037	19-Dec-11	REG	F88938
DS	CY3-SB02	CY0038	19-Dec-11	REG	F88938
SS	CY3-SB03	CY0039	19-Dec-11	REG	F88938
DS	CY3-SB03	CY0040	19-Dec-11	REG	F88938
DS	CY3-SB03	CY0041	19-Dec-11	REG	F88938
SS	CY3-SB04	CY0042	19-Dec-11	REG	F88938
DS	CY3-SB04	CY0043	19-Dec-11	REG	F88938
DS	CY3-SB04	CY0044	19-Dec-11	REG	F88938
GW	AP3-MW01	AP3083	19-Dec-11	REG	F88900
GW	AP3-MW01	AP3084	19-Dec-11	FD	F88900
GW	AP3-MW01	AP3085	19-Dec-11	FS	240-7113-1
GW	AP3-MW01	AP3088	30-May-12	REG	F93578
GW	AP3-MW02	AP3086	16-Dec-11	REG	F88782
GW	AP3-MW02	AP3091	30-May-12	REG	F93578
GW	AP3-MW03	AP3087	20-Dec-11	REG	F88900
GW	AP3-MW03	AP3092	30-May-12	REG	F93578

Notes:
AP3- Ash Pit No. 3.
CY3 - Coal Yard No. 3.
DS - Deep Soil (subsurface).
FD - Field Duplicate or quality control sample delivered to primary laboratory.
FS - Field Split or quality assurance sample delivered to alternate laboratory.
GW - Groundwater
REG - Regular Sample.
SDG - Sample Delivery Group.
SS - Surface Soil.

Table 3-2

Monitoring Well Construction Details
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well ID	Coordinates (Ohio Plane) Northings (y)	Eastings (x)	Well Depth (feet bgs)	Date Installed	Installed By	Casing Type	Casing Diameter (inches)	Borehole Diameter (inches)	Screen Interval (feet bgs)	Geologic Unit Screened	Top of Filter Pack (feet bgs)	TOC Elevation (feet msl)	Ground Elevation (feet msl)	Bedrock Elevation (feet msl)	Well Bottom Elevation (feet msl)
Monitoring Wells Screened in Overburden/Shale															
AP3-MW01	622910.53	1914684.10	21.50	8/16/2011	Shaw	PVC (40)	2	8	10.8-20.8	Overburden	7.5	638.03	638.50	na	617.70
AP3-MW02	622958.840	1914572.390	22.20	8/16/2011	Shaw	PVC (40)	2	8	12.0-22.0	Overburden	8.0	640.24	637.30	na	616.50
AP3-MW03	623077.560	1914421.690	20.20	8/17/2011	Shaw	PVC (40)	2	8	10.0-20.0	Overburden	7.0	639.28	636.20	na	615.40

Coordinates scaled to the Ohio State Plane coordinate system, North Zone, NAD 1983. Vertical datum is NAVD 1929.

Table 3-3

Final Monitoring Well Field Measurements
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Identification	Date	Sampling Method	Dissolved Oxygen (ppm)	Ferrous Iron (mg/L)	Oxidation Reduction Potential (mV)	pH	Specific Conductivity (mS/cm)	Temperature (^oC)	Turbidity (NTU)
Overburden/Shale Monitoring Wells									
AP3-MW01	12/19/2011	LF	1.12	0	-8.1	6.78	0.853	10.92	0
AP3-MW02	12/16/2011	LF	7.17	0	-16.1	7.12	1.191	8.74	0
AP3-MW03	12/20/2011	LF	8.29	0	-5.4	6.64	7.787	6.4	0
AP3-MW01	5/30/2012	SS	na	na	na	na	na	na	na
AP3-MW02	5/30/2012	SS	na	na	na	na	na	na	na
AP3-MW03	5/30/2012	SS	na	na	na	na	na	na	na

Notes:

Water quality measurements recorded by YSI water quality instrument immediately prior to the sample collection time.

No temporary piezometers, overburden/shale, or bedrock wells were installed at Ash Pit 3.

^oC - Degree Celsius.

Eh - oxidation-reduction potential.

L - Liters.

LF - low flow

mS/cm - Millisiemens per centimeter.

mV - Millivolts.

NM - Not measured.

NM - Not measured.

NM[a] - Water too turbid to read ferrous iron field test

ppm - Parts per million.

mg/L - Milligrams per liter (ppm).

NTU - Nephelometric turbidity unit.

SS - Snap Sampler™

Ferrous iron measured in field using Hach test kit.

na - not available (due to minimal sample volume, water quality readings were not recorded).

Table 4-1

Summary of Soil and Groundwater Analytical Parameters and Methods
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Matrix	Analytical Parameters[a]	Analytical Method[b]
Soil	TCL Semivolatile Organic Compounds	SW-846 3550C/8270D
	Nitroaromatic Compounds	SW-846 8330A
	Polychlorinated Biphenyls	SW-846 3550C/8082A
	TAL Metals	SW-846 3050B/6010C/7471B
	Total Organic Carbon	Walkley-Black
Liquid IDW	Target Compound List Volatile Organic Compound	SW-846 8260B
	Target Compound List Semivolatile Organic Compound	SW-846 3510C/8270D
	Nitroaromatics	SW-846 8330A
	Total Recoverable Metals	SW-846 3010A/6010C/7470A
	Ignitability	SW-846 1010A
	pH	SW-846 9040C
	Corrosivity	SW-846 1110A
	Reactive Cyanide	7.3.3/7.3.4
	Reactive Sulfide	7.3.3/7.3.4
Soil IDW	TCLP Volatile Organic Compounds	SW-846 1311/8260B
	TCLP Semivolatile Organic Compounds	SW-846 1311/3510C/8270C
	TCLP Metals	SW-846 1311/3010A/6010C/7470A
	Ignitability	SW-846 1010A
	Corrosivity	SW-846 1110A
	Reactivity	7.3.3.2/7.3.4.2

[a]Target analyte list (TAL) and target compound list (TCL) are used to designate parameter lists with no requirements for Contract Laboratory Program method quality control or data reporting packages.
[b]Analyses found in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* EPA Publication, Third Edition, and *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, March 1983 and subsequent revisions, except as noted.
[c]Water quality parameter.
[d]Field testing will use an appropriate field test kit or method according to EPA 600/4-79-020: Method for Chemical Analysis of Water and Wastes in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA Publication, Third Edition.

IDW - Investigation-derived waste.
SCR - Site characterization report.
TCLP - Toxicity characteristic leaching procedure.
TOC - Total organic compound.

Table 4-2

Background Screening Concentrations of Metals in Soil[a]
Ash pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works
Sandusky, Ohio

Chemical Name (mg/kg)	Frequency of Detection	Range of Detected Concentrations	Range of Reporting Limits [a]	Statistical Distribution	Arithmetic Mean	95% UTL [b]	Background Screening Criterion [c]
Aluminum	12 / 12	3520 - 15500	22.6 - 26.5	L	8.43E+03	2.69E+04	15500
Antimony	9 / 25	5.9 - 9.3	5.4 - 8.0	NP	4.68E+00	NA	9.30
Arsenic	23 / 26	2.1 - 36.5	1.1 - 24.7	L	1.08E+01	7.10E+01	36.5
Barium	9 / 12	35.6 - 826	22.6 - 26.5	L	1.16E+02	1.30E+03	826
Beryllium	6 / 25	0.57 - 1	0.57 - 1.2	L	5.65E-01	1.17E+00	1.00
Cadmium	0 / 25	NA	0.57 1.2	L	4.49E-01	NA	NA
Calcium	12 / 12	735 - 52300	566 - 663	L	1.13E+04	2.18E+05	52300
Chromium	25 / 26	4.4 - 29	1.1 - 12.3	NP	1.34E+01	NA	29.0
Cobalt	9 / 12	9.6 - 116	5.7 - 61.7	L	2.26E+01	2.48E+02	116
Copper	23 / 26	2.3 - 56.2	2.2 - 3.3	L	1.70E+01	1.47E+02	56.2
Iron	12 / 12	5880 - 234000	11.3 - 123	L	4.01E+04	3.58E+05	234000
Lead	26 / 26	1.9 - 48.6	0.34 - 7.4	L	1.28E+01	5.13E+01	48.6
Magnesium	12 / 12	629 - 10400	566 - 663	L	3.26E+03	3.08E+04	10400
Manganese	26 / 26	21 - 13300	1.7 - 18.5	L	7.29E+02	3.51E+03	3506
Mercury	2 / 26	0.085 - 0.085	0.037 - 0.3	L	9.06E-02	5.60E-01	0.085
Nickel	26 / 26	5.4 - 55.1	4.5 - 5.3	L	2.28E+01	7.79E+01	55.1
Potassium	11 / 12	579 - 3390	566 - 663	L	1.24E+03	6.08E+03	3390
Selenium	5 / 25	0.61 - 2	0.57 - 4.9	NP	1.55E+00	NA	2.00
Silver	2 / 26	1.1 - 11.1	1.1 - 1.3	NP	1.00E+00	NA	11.1
Sodium	0 / 12	NA	566 - 663	L	3.03E+02	NA	NA
Thallium	2 / 25	1.2 - 1.3	1.1 - 6.1	NP	1.91E+00	NA	1.30
Vanadium	11 / 12	9 - 40.9	5.7 - 61.7	L	2.48E+01	8.31E+01	40.9
Zinc	26 / 26	6.6 - 655	0.57 - 12.3	L	7.30E+01	3.22E+02	322

L - Lognormal; mg/kg - milligrams per kilogram; NP - nonparametric; NA - not applicable; not available.

[a] A single background sample had to be diluted such that the reporting limits of this sample (BCG-SB01, 6990) had to be diluted such that the reporting limits of this sample were elevated 10 or 20 times higher than they would have been if not diluted. This affects the maximum reporting limit shown for arsenic, chromium, cobalt, iron, lead, manganese, and vanadium. Reporting limits for these analytes in all other samples were much lower, approximately by an order of magnitude or more in each case.

[b] 95% UTL - 95% upper tolerance limit calculated as described in Shaw (2005).

[c] The maximum detected concentration is used as the background screening criterion for nonparametric data sets; for normal or lognormal data sets, the 95% UTL or the maximum detected concentration, whichever is less, is used.

Note: Detection limits from sample 6990 were deleted when calculating results for antimony, beryllium, cadmium, selenium, and thallium. The detection limits were elevated by dilution factors which greatly exceed any detected concentration and would bias results unrealistically high.

Source: IT Corporation, 2000, *TNT Area B Remedial Investigation, Volume II Baseline Human Health Risk Assessment* , Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, August, and reports referenced therein.

Table 4-3

Background Screening Concentrations for Inorganics and BTEX Compounds in Groundwater Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater Former Plum Brook Ordnance Works, Sandusky, Ohio

Chemical	Detection Frequency	Percent hits	Range of Values, µg/L: Detected Concentrations Minimum	Detected Concentrations Maximum	Reporting Limits Minimum	Reporting Limits Maximum	Mean µg/L	Standard Deviation	UTL [a] µg/L	BSC [b] µg/L
Metals - Unfiltered										
Aluminum	11 / 13	85	3.15E+01	3.09E+02	2.00E+02	2.00E+02	1.05E+02	6.98E+01	4.17E+02	309
Arsenic	4 / 26	15	3.30E+00	7.40E+00	1.00E+01	1.00E+01	4.99E+00	6.56E-01	7.92E+00	7.4
Barium	28 / 28	100	2.58E+01	1.18E+04	2.00E+02	2.00E+03	1.73E+03	3.77E+03	1.86E+04	11800
Calcium	28 / 28	100	1.74E+04	3.16E+05	5.00E+03	5.00E+03	1.38E+05	8.31E+04	5.09E+05	316000
Cobalt	6 / 27	22	1.00E+00	1.21E+01	5.00E+01	5.00E+01	2.05E+01	8.75E+00	5.96E+01	12.1
Copper	2 / 28	7	3.30E+00	1.98E+01	2.50E+01	2.50E+01	1.24E+01	2.26E+00	2.25E+01	19.8
Iron	24 / 27	89	3.82E+01	1.55E+03	1.00E+02	1.00E+02	4.15E+02	4.87E+02	2.59E+03	1550
Magnesium	28 / 28	100	7.28E+03	2.17E+05	5.00E+03	5.00E+03	7.17E+04	5.85E+04	3.33E+05	217000
Manganese	28 / 28	100	3.60E+00	6.88E+02	1.50E+01	1.50E+01	8.12E+01	1.24E+02	6.36E+02	636
Nickel	4 / 27	15	4.80E+00	8.60E+00	4.00E+01	4.00E+01	1.81E+01	4.67E+00	3.90E+01	8.6
Potassium	28 / 28	100	2.53E+03	1.16E+05	5.00E+03	5.00E+04	2.70E+04	3.06E+04	1.64E+05	116000
Sodium	28 / 28	100	1.33E+04	1.39E+06	5.00E+03	5.00E+04	3.55E+05	4.36E+05	2.30E+06	1390000
Zinc	14 / 19	74	8.30E-01	5.07E+02	2.00E+01	2.00E+01	5.55E+01	1.23E+02	6.06E+02	507
Volatile Organic Compounds										
Benzene	9 / 28	32	1.45E-01	2.40E+00	1.00E+00	5.00E+00	6.73E-01	5.43E-01	3.10E+00	2.4
Ethylbenzene	6 / 28	21	1.30E-01	8.70E-01	1.00E+00	5.00E+00	5.82E-01	4.00E-01	2.37E+00	0.87
Toluene	8 / 28	29	1.20E-01	1.70E+00	1.00E+00	5.00E+00	4.99E-01	2.83E-01	1.76E+00	1.7
Xylenes, total	8 / 28	29	3.60E-01	5.50E+00	1.00E+00	5.00E+00	1.22E+00	1.53E+00	8.07E+00	5.5

[a] The UTL (upper tolerance limit) is calculated using the Chebychev equation (mean + 4.47 * standard deviation).

[b] The BSC (background screening criterion) is the calculated UTL or the maximum detected concentration, whichever is less.

µg/L - Micrograms per liter.

mg/L - Milligrams per liter.

BTEX - Benzene, toluene, ethylbenzene, and xylenes.

Source: Shaw Environmental, Inc., 2005, 2004 Data Summary and Evaluation Report, Final, Plum Brook Ordnance Works, Sandusky, Ohio, April.

Table 5-1

Detected Constituents in Soil Samples
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

				LOCATION	CY3-SB01										CY3-SB02					
				SAMPLE NO	CY0031		CY0032		CY0033		CY0034		CY0035		CY0036		CY0037		CY0038	
				DATE	12/19/2011		12/19/2011		12/19/2011		12/19/2011		12/19/2011		12/19/2011		12/19/2011		12/19/2011	
				DEPTH	0.2 - 1.2 Ft		3 - 5 Ft		3 - 5 Ft		3 - 5 Ft		8 - 10 Ft		1.5 - 2.5 Ft		3 - 5 Ft		8 - 10 Ft	
				PURPOSE	REG		REG		FD		FS		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
SEMIVOLATILES																				
Acenaphthylene	mg/kg	NE	NE	0.0657	0.0657	J	-	-	-	-	-	-	-	-	0.0619	J	-	-	-	-
Anthracene	mg/kg	1,700	NE	0.171	0.171	J	-	-	-	-	-	-	-	-	0.0738	J	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	0.407	0.407		-	-	-	-	-	-	-	-	0.348		-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	0.403	0.326		-	-	-	-	-	-	-	-	0.403		-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	0.582	0.414		-	-	-	-	-	-	-	-	0.582		-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.277	0.203		-	-	-	-	-	-	-	-	0.277		-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	0.188	0.163	J	-	-	-	-	-	-	-	-	0.188	J	-	-	-	-
Chrysene	mg/kg	15	NE	0.443	0.387		-	-	-	-	-	-	-	-	0.443		-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.0589	0.0416	J	-	-	-	-	-	-	-	-	0.0589	J	-	-	-	-
Fluoranthene	mg/kg	230	NE	0.843	0.843		-	-	-	-	-	-	-	-	0.662		-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	0.294	0.223		-	-	-	-	-	-	-	-	0.294		-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.021	-	-	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	0.415	0.415		-	-	-	-	-	-	-	-	0.249		-	-	-	-
Pyrene	mg/kg	170	NE	0.636	0.636		-	-	-	-	-	-	-	-	0.508		-	-	-	-
METALS																				
Aluminum	mg/kg	7,700	15,500	11,400	7,110		11,400		11,400		8,700		6,040		4,130		8,230		6,530	
Antimony	mg/kg	3.1	9.3	0.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.15	J
Arsenic	mg/kg	0.39	36.5	12.9	8.8		8.7		12.9		4.2		8.6		3.6		7.5		5.6	
Barium	mg/kg	1,500	826	70.7	44.7		64.3		70.7		61		53.2		19.3		58.2		50.2	
Beryllium	mg/kg	16	1	0.7	0.42	J	0.7	J	0.61	J	0.18	J	0.3		0.19	J	0.49		0.38	
Cadmium	mg/kg	7	NE	0.61	0.16	J	-	-	-	-	0.054	J	0.11	J	-	-	-	-	0.42	
Calcium	mg/kg	NE	52,300	68,000	20,200		2,740		3,260		2,700		40,300		68,000		2,340		14,000	
Chromium	mg/kg	NE	29	17.2	9.6		15.6		17.2		12		10.7		6.7		12.1		9.4	
Cobalt	mg/kg	2.3	116	9	8.1		8.6	J	8.4	J	6		5.5		2.7		5.9		6.1	
Copper	mg/kg	310	56.2	19.5	15.2		13.2		19.5		9.2		14.3		7.4		12.2		13	
Iron	mg/kg	5,500	234,000	25,800	14,500		18,700		25,800		14,000		11,600		6,480		15,000		12,100	
Lead	mg/kg	40	48.6	12.8	11		8.6		9.7		5.7		9.7		5.8		9.3		9.7	
Magnesium	mg/kg	NE	10,400	12,900	5,920		2,250		1,970		2,000	B	**12,000**		5,020		1,600		6,010	
Manganese	mg/kg	180	3,506	436	316		426		291		230		274		240		251		269	
Mercury	mg/kg	1	0.09	0.05	0.029	J	0.021	J	0.049	J	0.022	J	0.013	J	0.03	J	0.033	J	0.022	J
Nickel	mg/kg	150	55.1	23.9	19.8		19.6		23.9		13		14.8		5.8		15.6		14.6	
Potassium	mg/kg	NE	3,390	1,010	755	J	697	J	598	J	550	J	982		273	J	478	J	465	J
Sodium	mg/kg	NE	NE	92.1	-	-	-	-	-	-	-	-	91.5	J	57	J	-	-	55.7	J
Thallium	mg/kg	0.078	1.3	1	-	-	-	-	-	-	1	J	-	-	-	-	-	-	-	-
Vanadium	mg/kg	39	40.9	33.4	16.2		27.3		33.4		19		12.2		10.7		23.7		16.2	
Zinc	mg/kg	2,300	321.75	50.4	48.9		38.5		50.4		30		38.3		14.6		30.9		29	
GENERAL CHEMISTRY																				
Total organic carbon	Percent	NE	NE	0.66	0.66		-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-1

Detected Constituents in Soil Samples
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

				LOCATION	CY3-SB03						CY3-SB04					
				SAMPLE NO	CY0039		CY0040		CY0041		CY0042		CY0043		CY0044	
				DATE	12/19/2011		12/19/2011		12/19/2011		12/19/2011		12/19/2011		12/19/2011	
				DEPTH	0 - 1 Ft		3 - 5 Ft		8 - 10 Ft		0 - 1 Ft		3 - 5 Ft		8 - 10 Ft	
				PURPOSE	REG		REG		REG		REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
SEMIVOLATILES																
Acenaphthylene	mg/kg	NE	NE	0.0657	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	1,700	NE	0.171	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.15	NE	0.407	0.0366	J	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	0.403	0.032	J	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	0.582	0.0291	J	-	-	-	-	-	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	NE	NE	0.277	0.0224	J	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	1.5	NE	0.188	0.0269	J	-	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	15	NE	0.443	0.0406	J	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.0589	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	230	NE	0.843	0.0525	J	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	0.294	0.0255	J	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	mg/kg	31	NE	0.021	0.021	J	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	NE	NE	0.415	0.0278	J	-	-	-	-	-	-	-	-	-	-
Pyrene	mg/kg	170	NE	0.636	0.0438	J	-	-	-	-	-	-	-	-	-	-
METALS																
Aluminum	mg/kg	7,700	15,500	11,400	5,780		7,270	J	7,100		4,640		8,390		7,330	
Antimony	mg/kg	3.1	9.3	0.29	-	-	-	-	0.29	J	-	-	-	-	-	-
Arsenic	mg/kg	0.39	36.5	12.9	7.2		3.7	J	4.8		4.9		7.8		7.3	
Barium	mg/kg	1,500	826	70.7	37.4		51	J	46.1		42.4		66.3		59.6	
Beryllium	mg/kg	16	1	0.7	0.3		0.38	J	0.37		0.25		0.49	J	0.38	
Cadmium	mg/kg	7	NE	0.61	0.18	J	0.26	J	0.61		0.14	J	-	-	0.21	J
Calcium	mg/kg	NE	52,300	68,000	38,500		2,850	J	28,500		31,800		2,860		42,700	
Chromium	mg/kg	NE	29	17.2	10.3		9.1	J	10.4		8.6		12.6		14.3	
Cobalt	mg/kg	2.3	116	9	6.7		3.6	J	6.2		4.7		6.7		9	
Copper	mg/kg	310	56.2	19.5	14.7		10.5	J	16.1		12		15.7		18.9	
Iron	mg/kg	5,500	234,000	25,800	12,100		9,520	J	13,600		8,830		16,400		13,900	
Lead	mg/kg	40	48.6	12.8	10		9.4	J	10		9.9		9.4		12.8	
Magnesium	mg/kg	NE	10,400	12,900	10,900		1,450	J	9,740		9,390		1,990		**12,900**	
Manganese	mg/kg	180	3,506	436	325		158	J	346		236		436		400	
Mercury	mg/kg	1	0.09	0.05	0.018	J	0.05	J	0.019	J	0.02	J	0.034	J	0.015	J
Nickel	mg/kg	150	55.1	23.9	17.5		8.8	J	17.3		12		18.7		21.6	
Potassium	mg/kg	NE	3,390	1,010	921		387	J	929		558		454	J	1,010	
Sodium	mg/kg	NE	NE	92.1	92.1	J	-	-	76.9	J	70	J	-	-	89.1	J
Thallium	mg/kg	0.078	1.3	1	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	39	40.9	33.4	13.5		16.3	J	15.6		10.6		22.4		16	
Zinc	mg/kg	2,300	321.75	50.4	38.7		25.9	J	38		33.3		39.3		48.5	
GENERAL CHEMISTRY																
Total organic carbon	Percent	NE	NE	0.66	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-1

Detected Constituents in Soil Samples
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

mg/kg - Milligrams per kilogram.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and an HQ of 0.1), that concentration is selected as the RBSC.
BSC - Background screening concentration.
MDC - Maximum detected concentration for the area of concern.
Shaded cell indicates value is greater than RBSC.
Bolded text indicates values are greater than BSC.
NE - Not established (RBSCs), not evaluated (BSCs).
"-" - Not detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified; the reported value is estimated.
B - The analyte was not detected significantly above the levels found in the associated method blank or field blanks.

Table 5-2

Detected Constituents in Overburden/Shale Monitoring Wells
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and AP3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

				LOCATION CODE	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01		
				SAMPLE NUMBER	AP3083			AP3084			AP3085			AP3088		
				SAMPLE DATE	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12		
				DEPTH	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft		
				PURPOSE	REG			FD			FS			REG		
Parameter	Units	RBSC	BSC	MDC	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ
EXPLOSIVES																
Nitrotoluene, 2-	µ/L	0.27	NE	0.18	-	-	-	-	-	-	-	-	-	0.18	J	J
VOLATILES																
Acetone	µ/L	1,200	NE	17.6	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	µ/L	19	NE	1.6	-	-	-	-	-	-	-	-	-	-	-	-
Dichloroethane, 1,1-	µ/L	2.4	NE	1.7	1.7			1.6			1.3			-	-	-
Trichloroethane, 1,1,1-	µ/L	750	NE	0.27	0.27	J	J	0.26	J	J	-	-	-	-	-	-
SEMIVOLATILES																
Bis(2-ethylhexyl)phthalate	µ/L	0.071	NE	0.8	-	-	-	-	-	-	**0.8**	J B	B			
METALS (UNFILTERED)																
Aluminum	µ/L	1,600	309	88.9	-	-	-	-	-	-	-	-	-	71	B	J
Arsenic	µ/L	0.045	7.4	9.9	-	-	-	-	-	-	-	-	-	**9.9**	B	J
Barium	µ/L	290	11,800	220	40.6	B	J	39.5	B	J	45	J	J	110	B	J
Calcium	µ/L	NE	316,000	161,000	117,000		J	121,000		J	130,000			116,000		
Chromium	µ/L	NE	NE	1.3	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	µ/L	0.47	12.1	2.1	**1.2**	B	J	**1.1**	B	J	**1.7**	J	J	-	-	-
Copper	µ/L	62	19.8	0	-	-	-	-	-	-	-	-	-	-	-	-
Iron	µ/L	1,100	1,550	2,240	57.5	B	J	70.6	B	J	130	J	J	**2,240**		
Magnesium	µ/L	NE	217,000	71,600	25,900		J	27,700		J	29,000	B		45,900		
Manganese	µ/L	32	636	1,900	**1,760**			**1,780**			**1,900**			**779**		
Nickel	µ/L	30	8.6	2.4	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	µ/L	NE	116,000	11,100	805	B	J	716	B	J	900	J	J	4,050	B	J
Selenium	µ/L	7.8	NE	0	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	µ/L	NE	1,390,000	154,000	20,100			19,500			20,000			20,100		
Vanadium	µ/L	7.8	NE	2.1	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	µ/L	470	507	18.4	-	-	-	-	-	-	-	-	-	15.1	B	J
METALS (FILTERED)																
Aluminum	µ/L	1,600	309	46.7	-	-	-	-	-	-	-	-	-			
Arsenic	µ/L	0.045	7.4	4.1	-	-	-	-	-	-	**4.1**	J	J			
Barium	µ/L	290	11,800	75.3	40.5	B	J	43.5	B	J	46	J	J			
Calcium	µ/L	NE	316,000	169,000	119,000			125,000			130,000					
Chromium	µ/L	NE	NE	0	-	-	-	-	-	-	-	-	-			
Cobalt	µ/L	0.47	12.1	1.4	**1.4**	B	J	**1.3**	B	J	-	-	-			
Copper	µ/L	62	19.8	7.3	7.3	B	J	-	-	-	-	-	-			
Iron	µ/L	1,100	1,550	81	74.1	B	J	67.4	B	J	81	J	J			
Magnesium	µ/L	NE	217,000	54,100	27,400			29,000			29,000	B				
Manganese	µ/L	32	636	1,900	**1,720**			**1,800**			**1,900**					
Nickel	µ/L	30	8.6	0	-	-	-	-	-	-	-	-	-			
Potassium	µ/L	NE	116,000	11,300	744	B	J	766	B	J	860	J	J			
Selenium	µ/L	7.8	NE	2.9	-	-	-	-	-	-	-	-	-			
Sodium	µ/L	NE	1,390,000	153,000	19,800			21,300			19,000					
Vanadium	µ/L	7.8	NE	2.4	-	-	-	-	-	-	-	-	-			
Zinc	µ/L	470	507	0	-	-	-	-	-	-	-	-	-			

Table 5-2

Detected Constituents in Overburden/Shale Monitoring Wells
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and AP3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

				LOCATION CODE	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01		
				SAMPLE NUMBER	AP3083			AP3084			AP3085			AP3088		
				SAMPLE DATE	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12		
				DEPTH	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft		
				PURPOSE	REG			FD			FS			REG		
Parameter	Units	RBSC	BSC	MDC	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ
WATER QUALITY PARAMETERS																
Alkalinity	µ/L	NE	NE	300,000							300,000					
Alkalinity, Carbonate	µ/L	NE	NE	398,000	302,000		J	305,000		J						
Chloride	µ/L	NE	NE	27,000	1,800	B	J	1,700	B	J	1,700					
Hardness (as CaCO3)	µ/L	NE	NE	644,000	399,000			416,000			470,000			479,000		
Nitrate-Nitrite	µ/L	NE	NE	530	-	-	-	52	B	J	65	J B	B			
Sulfate	µ/L	NE	NE	538,000	162,000		J	167,000		J	180,000					
Total dissolved solids	µ/L	NE	NE	1,210,000	557,000		J	398,000		J	530,000					
Total suspended solids	µ/L	NE	NE	8,000	-	-	-	-	-	-	-	-	-			
Turbidity	NTU	NE	NE	1.2	-	-	-	-	-	-	1	H				

Table 5-2

Detected Constituents in Overburden/Shale Monitoring Wells
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and AP3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

				LOCATION CODE	AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
				SAMPLE NUMBER	AP3086			AP3091			AP3087			AP3092		
				SAMPLE DATE	16-Dec-11			30-May-12			20-Dec-11			30-May-12		
				DEPTH	10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
				PURPOSE	REG			REG			REG			REG		
Parameter	Units	RBSC	BSC	MDC	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ
EXPLOSIVES																
Nitrotoluene, 2-	µ/L	0.27	NE	0.18	-	-	-	-	-	-	-	-	-	-	-	-
VOLATILES																
Acetone	µ/L	1,200	NE	17.6	-	-	-	-	-	-	17.6	J	J	-	-	-
Chloromethane	µ/L	19	NE	1.6	-	-	-	-	-	-	1.6	J	J	-	-	-
Dichloroethane, 1,1-	µ/L	2.4	NE	1.7	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethane, 1,1,1-	µ/L	750	NE	0.27	-	-	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILES																
Bis(2-ethylhexyl)phthalate	µ/L	0.071	NE	0.8	-	-	-				-	-	-			
METALS (UNFILTERED)																
Aluminum	µ/L	1,600	309	88.9	-	-	-	40.2	B	J	88.9	B	J	34.9	B	J
Arsenic	µ/L	0.045	7.4	9.9	-	-	-	**5.2**	B	J	-	-	-	-	-	-
Barium	µ/L	290	11,800	220	220		J	113	B	J	67	B	J	47.5	B	J
Calcium	µ/L	NE	316,000	161,000	140,000		J	118,000			161,000		J	157,000		
Chromium	µ/L	NE	NE	1.3	1.3	B	J	-	-	-	-	-	-	-	-	-
Cobalt	µ/L	0.47	12.1	2.1	-	-	-	**2.1**	B	J	-	-	-	**1.6**	B	J
Copper	µ/L	62	19.8	0	-	-	-	-	-	-	-	-	-	-	-	-
Iron	µ/L	1,100	1,550	2,240	-	-	-	661			-	-	-	631		
Magnesium	µ/L	NE	217,000	71,600	71,600		J	66,300			51,200		J	55,200		
Manganese	µ/L	32	636	1,900	**52**			**270**			**151**			**472**		
Nickel	µ/L	30	8.6	2.4	-	-	-	-	-	-	2.4	B	J	-	-	-
Potassium	µ/L	NE	116,000	11,100	3,840	B	J	5,030	B	J	11,100			4,680	B	J
Selenium	µ/L	7.8	NE	0	-	-	-	-	-	-	-	-	-	-	-	-
Sodium	µ/L	NE	1,390,000	154,000	23,300			40,100			154,000			105,000		
Vanadium	µ/L	7.8	NE	2.1	2.1	B	J	-	-	-	2.1	B	J	-	-	-
Zinc	µ/L	470	507	18.4	7.6	B	J	13	B	J	7.7	B	J	18.4	B	J
METALS (FILTERED)																
Aluminum	µ/L	1,600	309	46.7							46.7	B	J			
Arsenic	µ/L	0.045	7.4	4.1							-	-	-			
Barium	µ/L	290	11,800	75.3							75.3	B	J			
Calcium	µ/L	NE	316,000	169,000							169,000					
Chromium	µ/L	NE	NE	0							-	-	-			
Cobalt	µ/L	0.47	12.1	1.4							-	-	-			
Copper	µ/L	62	19.8	7.3							-	-	-			
Iron	µ/L	1,100	1,550	81							-	-	-			
Magnesium	µ/L	NE	217,000	54,100							54,100					
Manganese	µ/L	32	636	1,900							**151**					
Nickel	µ/L	30	8.6	0							-	-	-			
Potassium	µ/L	NE	116,000	11,300							11,300					
Selenium	µ/L	7.8	NE	2.9							2.9	B	J			
Sodium	µ/L	NE	1,390,000	153,000							153,000					
Vanadium	µ/L	7.8	NE	2.4							2.4	B	J			
Zinc	µ/L	470	507	0							-	-	-			

Table 5-2

Detected Constituents in Overburden/Shale Monitoring Wells
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and AP3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

				LOCATION CODE	AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
				SAMPLE NUMBER	AP3086			AP3091			AP3087			AP3092		
				SAMPLE DATE	16-Dec-11			30-May-12			20-Dec-11			30-May-12		
				DEPTH	10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
				PURPOSE	REG			REG			REG			REG		
Parameter	Units	RBSC	BSC	MDC	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ	Result	Qual	VQ
WATER QUALITY PARAMETERS																
Alkalinity	µ/L	NE	NE	300,000												
Alkalinity, Carbonate	µ/L	NE	NE	398,000	392,000						398,000		J			
Chloride	µ/L	NE	NE	27,000	11,000						27,000					
Hardness (as CaCO3)	µ/L	NE	NE	644,000	644,000			568,000			613,000			619,000		
Nitrate-Nitrite	µ/L	NE	NE	530	530						420					
Sulfate	µ/L	NE	NE	538,000	305,000						538,000					
Total dissolved solids	µ/L	NE	NE	1,210,000	788,000						1,210,000					
Total suspended solids	µ/L	NE	NE	8,000	-	-	-				8,000	B	J			
Turbidity	NTU	NE	NE	1.2	1.2						-	-	-			

BSC - Background screening concentration.
MDC - Maximum detected concentration for the area of concern ("B" qualified data not included).
µ/L - Micrograms per liter.
NE - Not established (RBSCs), not evaluated (BSCs).
Shaded cell indicates value is greater than RBSC.
RBSC - Values reflect an incremental lifetime cancer risk (ICLR) of 1E-6 or a noncancer hazard quotient (HQ) of 0.1. For chemicals that exhibit both cancer and noncancer effects, whichever type of effect results in a lower concentration (using an ICLR of 1E-6 and and HQ of 0.1), that concentration is selected as the RBSC.
Bold text indicates value is greater than BSC.
Blank cell means that parameter was not analyzed.
"-" - Not detected.

Validation Qualifiers (VQ)
J - The analyte was positively identified, the reported value is estimated.
B - The compound/analyte was detected in a lab or field blank.

Table 5-3

Low-Flow and Snap Sampler™ Groundwater Analytical Comparison
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Collection Method:		Low-Flow			Snap Sampler			RPD
Location:		AP1-MW01			AP1-MW01			
Sample Number:		AP3089			AP3090			
Sample Date:		30-MAY-12			30-MAY-12			
Sample Purpose:		REG			REG			
		Result	LQ	VQ	Result	LQ	VQ	(%)
Total Recoverable Metals								
Hardness (as CaCO3)	ppm	857			789			8.26
Aluminum	µ/L	35.7	B	J	39.5	B	J	10.11
Iron	µ/L	14400			16600			14.19
Lead	µ/L	1.1	B	J	5	U	U	127.87
Magnesium	µ/L	54800			48000			13.23
Manganese	µ/L	16100			8480			62.00
Mercury	µ/L	1	U	U	1	U	U	0.00
Nickel	µ/L	4.8	B	J	2.5	B	J	63.01
Potassium	µ/L	2070	B	J	3090	B	J	39.53
Silver	µ/L	2.1	B	J	1.2	B	J	54.55
Sodium	µ/L	34200			43300			23.48
Thallium	µ/L	10	U	U	10	U	U	0.00
Antimony	µ/L	6	U	U	6	U	U	0.00
Arsenic	µ/L	8.2	B	J	8.1	B	J	1.23
Barium	µ/L	32.5	B	J	32.9	B	J	1.22
Beryllium	µ/L	4	U	U	4	U	U	0.00
Cadmium	µ/L	5	U	U	5	U	U	0.00
Chromium	µ/L	2.5	B	J	1.6	B	J	43.90
Cobalt	µ/L	10	B	J	4.6	B	J	73.97
Copper	µ/L	25	U	U	25	U	U	0.00
Vanadium	µ/L	50	U	U	50	U	U	0.00
Zinc	µ/L	20	U	U	20	U	U	0.00
Calcium	µ/L	253000			237000			6.53
Selenium	µ/L	10	U	U	10	U	U	0.00

RPD - Relative percent difference between groundwater samples. (When analytical compounds containing qualifiers below the limit of quantitation (B) and non detect (U) are removed, the only Total Recoverable Metal remaining above 30% is manganese).
U - Non detect.
B - Result below limit of quatitation.
J - Estimated concenetration.

FIGURES

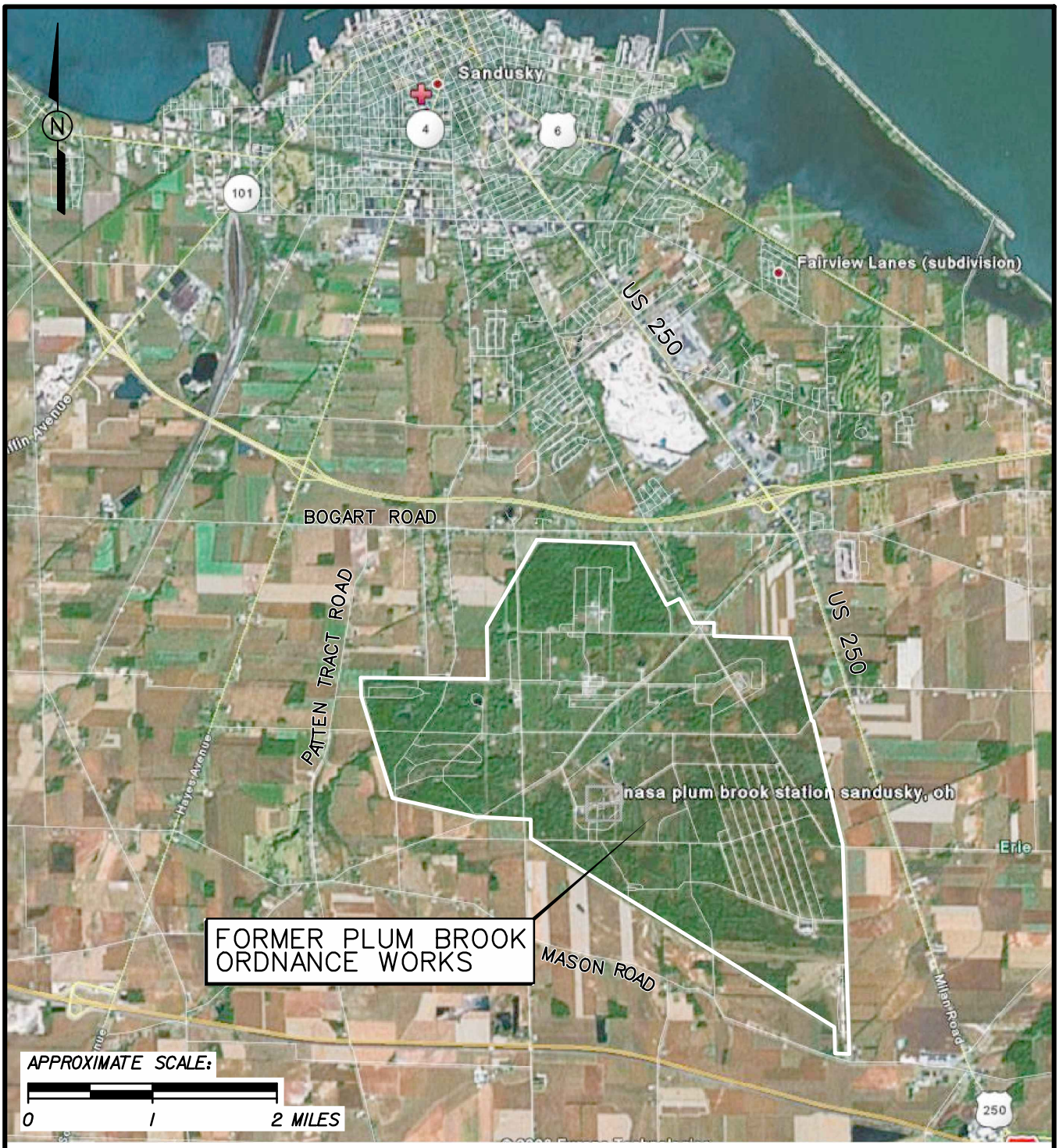

FIGURE 1-1
PBOW VICINITY MAP

ASH PIT 1 AND ASH PIT 3 SCR ADDENDUM FOR COAL YARD No.3 SOIL AND ASH PIT No.3 GROUNDWATER FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

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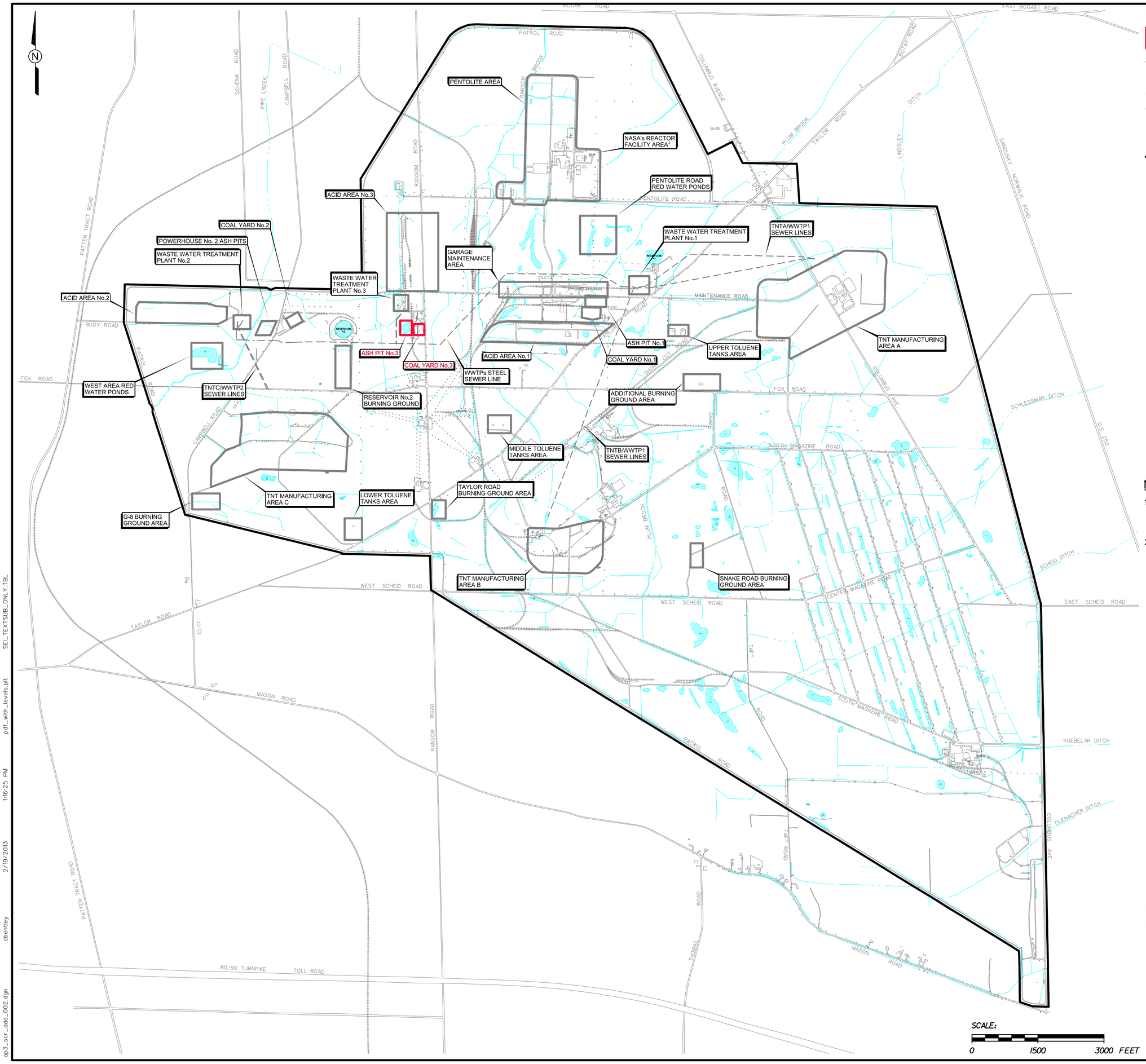

LEGEND:

- AREA OF CONCERN
- APPROXIMATE LOCATION OF SEWER LINES
- POND
- CREEK, DITCH, CONVEYANCE
- FORMER RAILROAD
- ROAD
- FENCE
- FACILITY BOUNDARY

NOTES:

1. SNAKE ROAD BURNING GROUND AREA WAS ALSO REFERRED TO AS "SNAKE ROAD BURN PIT", "SCHEID ROAD BURNING GROUNDS", AND "DISPOSAL AREA THREE".
2. REACTOR FACILITY CONSTRUCTED BY NASA POST WWII AND IS IDENTIFIED FOR LOCATION PURPOSES ONLY.

FIGURE 1-2
LOCATION OF COAL YARD No.3 AND ASH PIT No.3 AT PBOW

ASH PIT 1 AND ASH PIT 3 SCR ADDENDUM FOR COAL YARD No.3 SOIL AND ASH PIT No.3 GROUNDWATER
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

CBI

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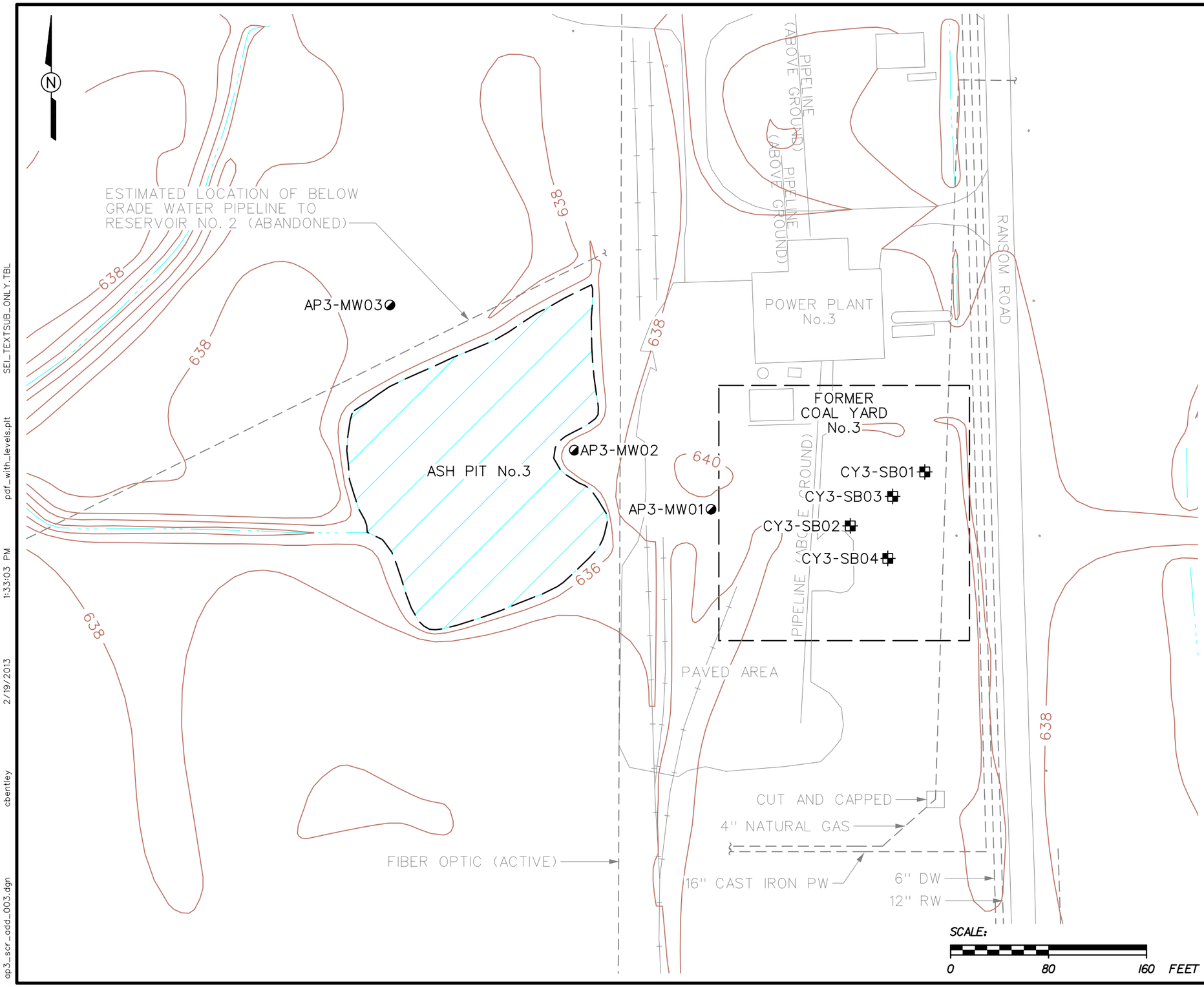
Figure 1-3
Coal Yard No. 3 and Ash Pit No. 3, Circa 1958 Photo
(View is to the Southeast)



LEGEND:

- OVERBURDEN/SHALE MONITORING WELL
- SOIL BORING
- POND
- CREEK, DITCH, CONVEYANCE
- FORMER RAILROAD
- ROAD
- UNDERGROUND UTILITIES (APPROXIMATE)
- 640 TOPOGRAPHIC CONTOUR (2 FT. INTERVAL)

NOTES:

1. FORMER COAL YARD NO.3 PERIMETER IS BASED ON HISTORICAL AERIAL PHOTOGRAPHY AND IS APPROXIMATE.

FIGURE 2-1
GENERAL SITE FEATURES OF COAL YARD No.3 AND ASH PIT No.3 WITH SITE TOPOGRAPHY AND SAMPLE LOCATIONS

ASH PIT 1 AND ASH PIT 3 SCR ADDENDUM FOR COAL YARD No.3 SOIL AND ASH PIT No.3 GROUNDWATER
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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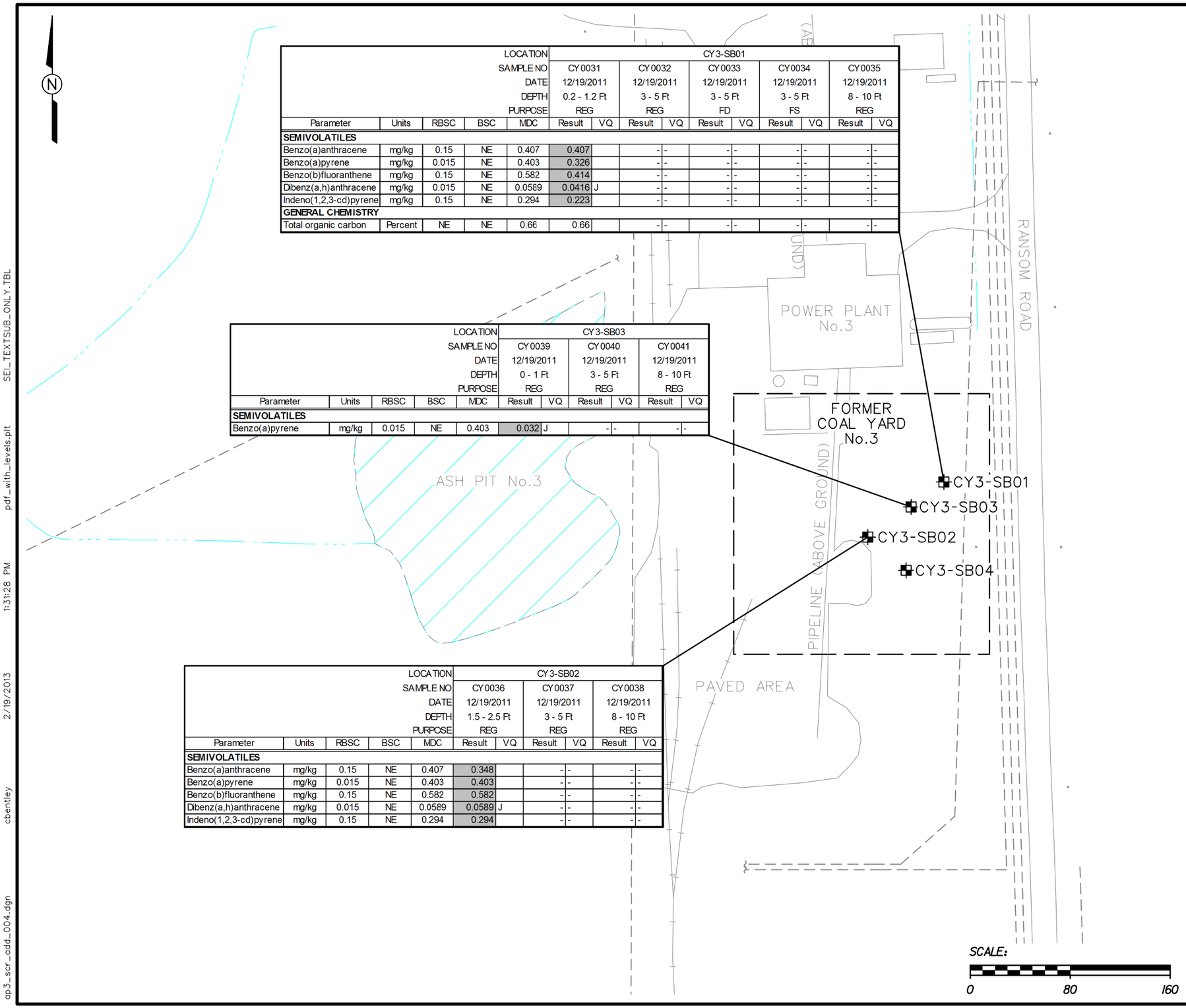

				LOCATION	CY3-SB01									
				SAMPLE NO	CY0031		CY0032		CY0033		CY0034		CY0035	
				DATE	12/19/2011		12/19/2011		12/19/2011		12/19/2011		12/19/2011	
				DEPTH	0.2 - 1.2 Ft		3 - 5 Ft		3 - 5 Ft		3 - 5 Ft		8 - 10 Ft	
				PURPOSE	REG		REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
SEMIVOLATILES														
Benzo(a)anthracene	mg/kg	0.15	NE	0.407	0.407		-	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	0.403	0.326		-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	0.582	0.414		-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.0589	0.0416	J	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	0.294	0.223		-	-	-	-	-	-	-	-
GENERAL CHEMISTRY														
Total organic carbon	Percent	NE	NE	0.66	0.66		-	-	-	-	-	-	-	-

				LOCATION	CY3-SB03					
				SAMPLE NO	CY0039		CY0040		CY0041	
				DATE	12/19/2011		12/19/2011		12/19/2011	
				DEPTH	0 - 1 Ft		3 - 5 Ft		8 - 10 Ft	
				PURPOSE	REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ
SEMIVOLATILES										
Benzo(a)pyrene	mg/kg	0.015	NE	0.403	0.032	J	-	-	-	-

				LOCATION	CY3-SB02					
				SAMPLE NO	CY0036		CY0037		CY0038	
				DATE	12/19/2011		12/19/2011		12/19/2011	
				DEPTH	1.5 - 2.5 Ft		3 - 5 Ft		8 - 10 Ft	
				PURPOSE	REG		REG		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ
SEMIVOLATILES										
Benzo(a)anthracene	mg/kg	0.15	NE	0.407	0.348		-	-	-	-
Benzo(a)pyrene	mg/kg	0.015	NE	0.403	0.403		-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.15	NE	0.582	0.582		-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.015	NE	0.0589	0.0589	J	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.15	NE	0.294	0.294		-	-	-	-

LEGEND:

- SOIL BORING
- POND
- CREEK, DITCH, CONVEYANCE
- FORMER RAILROAD
- ROAD
- UNDERGROUND UTILITIES (APPROXIMATE)
- mg/kg — MILLIGRAMS PER KILOGRAM
- NE — NOT ESTABLISHED (RBSCs), NOT EVALUATED (BSCs)
- \- — NOT DETECTED

NOTES:

1. SHADED CELL INDICATES VALUE IS GREATER THAN THE RISK-BASED SCREENING CONCENTRATION (RBSC).
2. BOLD TEXT INDICATES VALUE IS GREATER THAN THE BACKGROUND SCREENING CONCENTRATION (BSC).
3. RBSC VALUES REFLECT AN INCREMENTAL LIFETIME CANCER RISK (ILCR) OF 1E-6 OR A NONCANCER HAZARD QUOTIENT (HQ) OF 0.1. FOR CHEMICALS THAT EXHIBIT BOTH CANCER AND NONCANCER EFFECTS, WHICHEVER TYPE OF EFFECT IN A LOWER CONCENTRATION (USING AN ILCR OF 1E-6 AND AN HQ OF 0.1), THAT CONCENTRATION IS SELECTED AS THE RBSC.
4. MDC IS MAXIMUM DETECTED CONCENTRATION FOR THE INVESTIGATION AREA ("B" QUALIFIED DATA NOT INCLUDED).
5. VALIDATION QUALIFIERS (VQ):
   J - THE ANALYTE WAS POSITIVELY IDENTIFIED; THE REPORTED VALUE IS ESTIMATED.

FIGURE 5-1
DETECTED CONSTITUENTS AT COAL YARD No.3 IN SURFACE AND SUBSURFACE SOIL ABOVE RBSCs AND/OR BSCs (DECEMBER 2011)

ASH PIT 1 AND ASH PIT 3 SCR ADDENDUM FOR COAL YARD No.3 SOIL AND ASH PIT No.3 GROUNDWATER
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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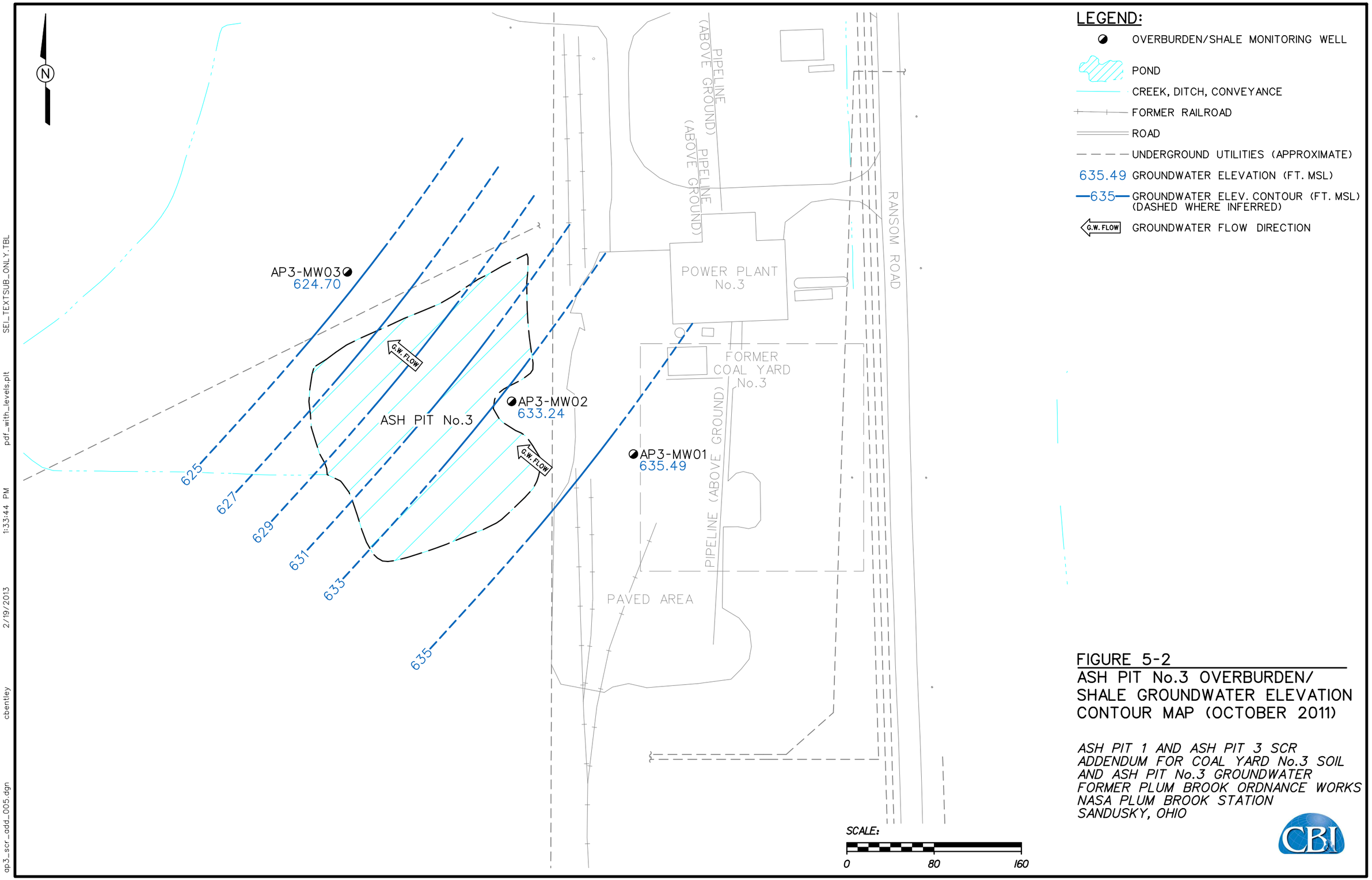

FIGURE 5-2
ASH PIT No.3 OVERBURDEN/ SHALE GROUNDWATER ELEVATION CONTOUR MAP (OCTOBER 2011)

ASH PIT 1 AND ASH PIT 3 SCR ADDENDUM FOR COAL YARD No.3 SOIL AND ASH PIT No.3 GROUNDWATER FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

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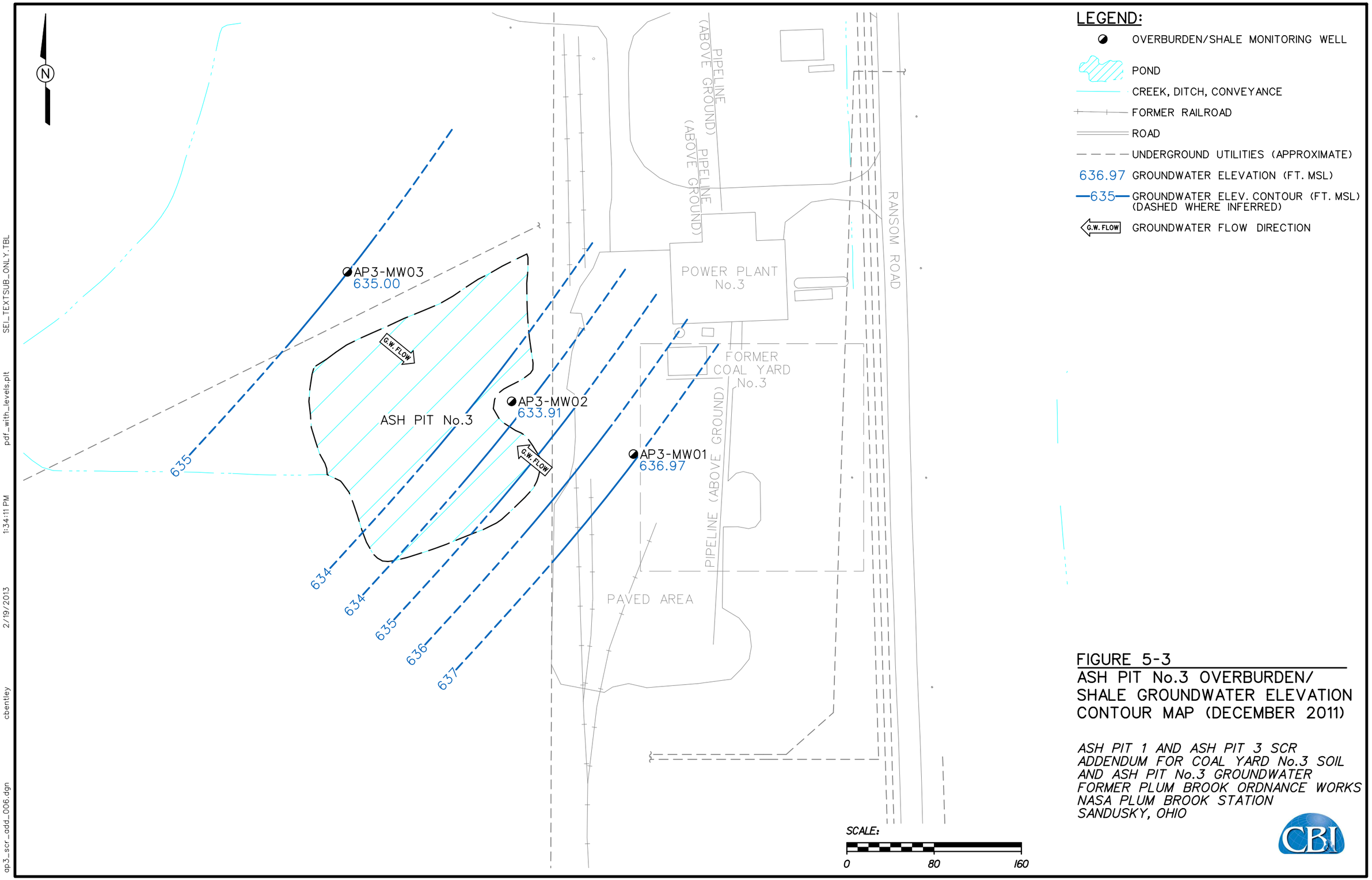

FIGURE 5-3
ASH PIT No.3 OVERBURDEN/ SHALE GROUNDWATER ELEVATION CONTOUR MAP (DECEMBER 2011)

ASH PIT 1 AND ASH PIT 3 SCR ADDENDUM FOR COAL YARD No.3 SOIL AND ASH PIT No.3 GROUNDWATER FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

CBI

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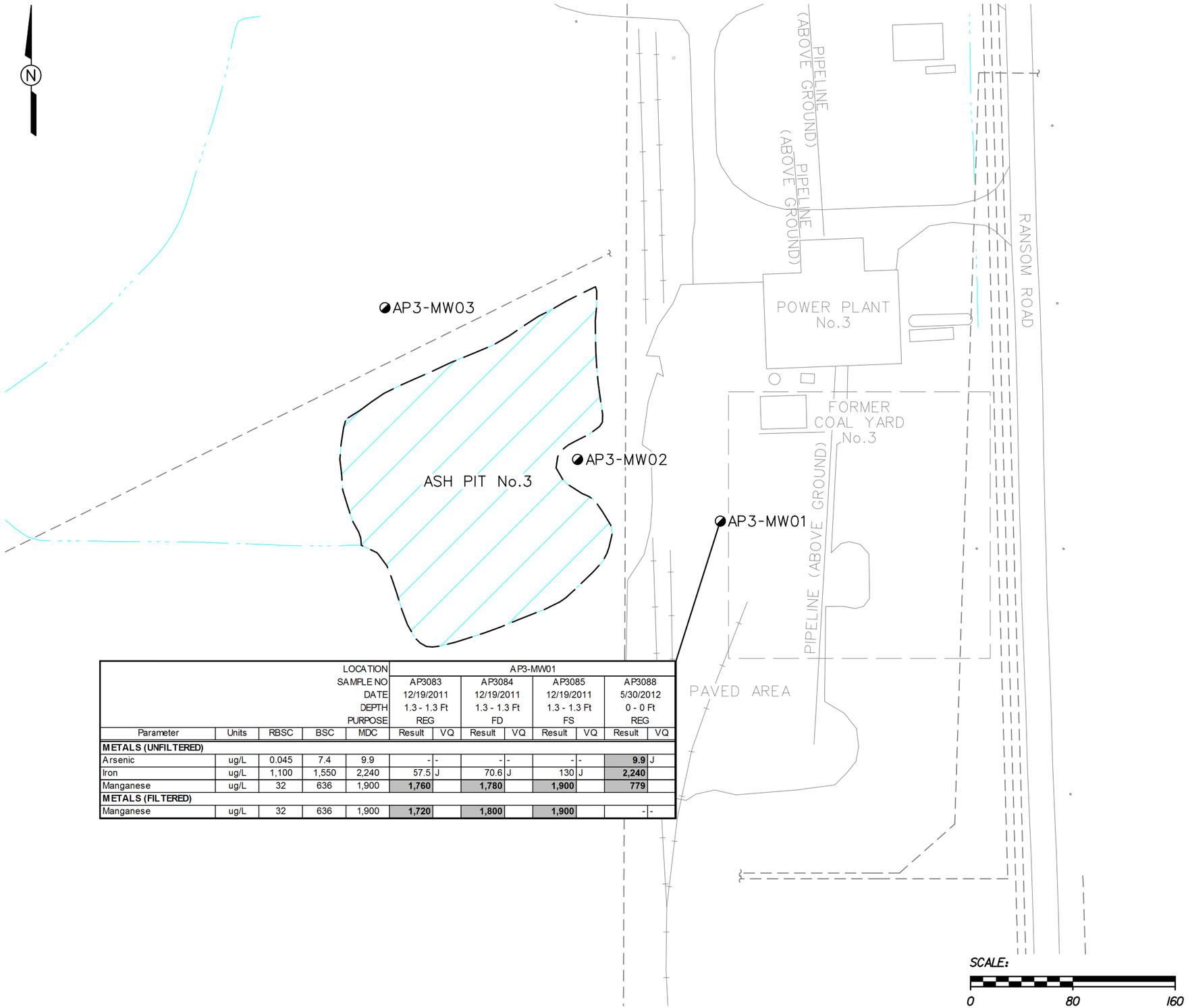

				LOCATION	AP3-MW01							
				SAMPLE NO	AP3083		AP3084		AP3085		AP3088	
				DATE	12/19/2011		12/19/2011		12/19/2011		5/30/2012	
				DEPTH	1.3 - 1.3 Ft		1.3 - 1.3 Ft		1.3 - 1.3 Ft		0 - 0 Ft	
				PURPOSE	REG		FD		FS		REG	
Parameter	Units	RBSC	BSC	MDC	Result	VQ	Result	VQ	Result	VQ	Result	VQ
METALS (UNFILTERED)												
Arsenic	ug/L	0.045	7.4	9.9	-	-	-	-	-	-	**9.9**	J
Iron	ug/L	1,100	1,550	2,240	57.5	J	70.6	J	130	J	**2,240**	
Manganese	ug/L	32	636	1,900	**1,760**		**1,780**		**1,900**		**779**	
METALS (FILTERED)												
Manganese	ug/L	32	636	1,900	**1,720**		**1,800**		**1,900**		-	-

LEGEND:

- OVERBURDEN/SHALE MONITORING WELL
- POND
- CREEK, DITCH, CONVEYANCE
- FORMER RAILROAD
- ROAD
- UNDERGROUND UTILITIES (APPROXIMATE)
- ug/L — MICROGRAMS PER LITER
- NE — NOT ESTABLISHED (RBSCs), NOT EVALUATED (BSCs)
- \- — NOT DETECTED

NOTES:

1. SHADED CELL INDICATES VALUE IS GREATER THAN THE RISK-BASED SCREENING CONCENTRATION (RBSC).
2. BOLD TEXT INDICATES VALUE IS GREATER THAN THE BACKGROUND SCREENING CONCENTRATION (BSC).
3. RBSC VALUES REFLECT AN INCREMENTAL LIFETIME CANCER RISK (ILCR) OF 1E-6 OR A NONCANCER HAZARD QUOTIENT (HQ) OF 0.1. FOR CHEMICALS THAT EXHIBIT BOTH CANCER AND NONCANCER EFFECTS, WHICHEVER TYPE OF EFFECT IN A LOWER CONCENTRATION (USING AN ILCR OF 1E-6 AND AN HQ OF 0.1), THAT CONCENTRATION IS SELECTED AS THE RBSC.
4. MDC IS MAXIMUM DETECTED CONCENTRATION FOR THE INVESTIGATION AREA ("B" QUALIFIED DATA NOT INCLUDED).
5. VALIDATION QUALIFIERS (VQ):
   J - THE ANALYTE WAS POSITIVELY IDENTIFIED; THE REPORTED VALUE IS ESTIMATED.

FIGURE 5-4
DETECTED CONSTITUENTS AT ASH PIT No.3 IN OVERBURDEN/ SHALE GROUNDWATER ABOVE RBSCs AND/OR BSCs (DECEMBER 2011 AND MAY 2012)

ASH PIT 1 AND ASH PIT 3 SCR ADDENDUM FOR COAL YARD No.3 SOIL AND ASH PIT No.3 GROUNDWATER
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

CBI

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APPENDIX A

SAMPLE COLLECTION LOGS

Shaw™
Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB 122111 ACCT

Location Code: CY3-SB01
Sample Number: CY0031
Sample Name: PB11-DS-CY3-SB01-CY0031-(0-1)-REG
Sampling Method: HA
Sample Type: SS *Sample Purpose:* REG
Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: 1105
Start Depth: 0.2'
End Depth: 1.2'
Sample Matrix: SOIL
Sample Team: EW/KB

QC Partners:
(TB) (ER) (FB)

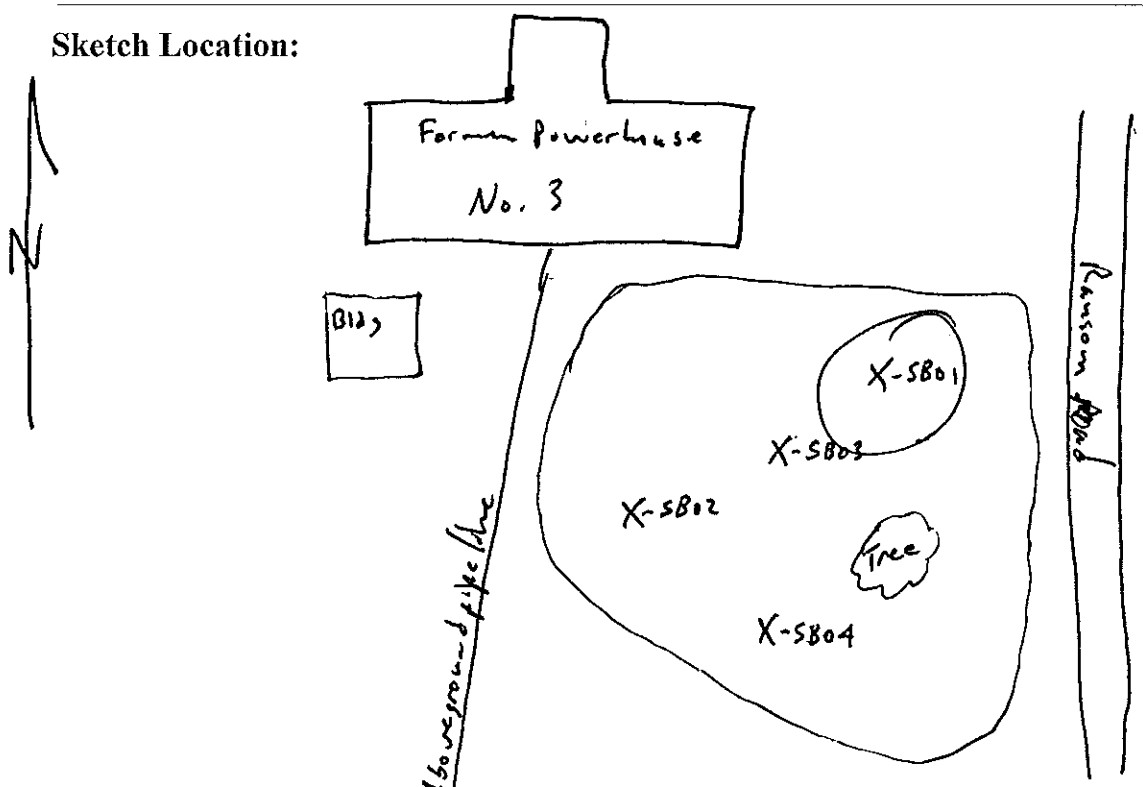
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM
TOC	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E. W. Wenner 12-19-11 *Reviewed BY / Date:* Edward K. Mean 1-26-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111ACCT

Location Code: CY3-SB01 EW

Sample Number: CY0032

Sample Name: PB11-DS-CY3-SB01 EW-CY0032-(3-5)-REG

Sampling Method: SS

Sample Type: DS *Sample Purpose:* REG

Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1119

Start Depth: 3'

End Depth: 5'

Sample Matrix: SOIL

QC Partners:

(TB) (ER) (FB)

Sample Team: EW/KB

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

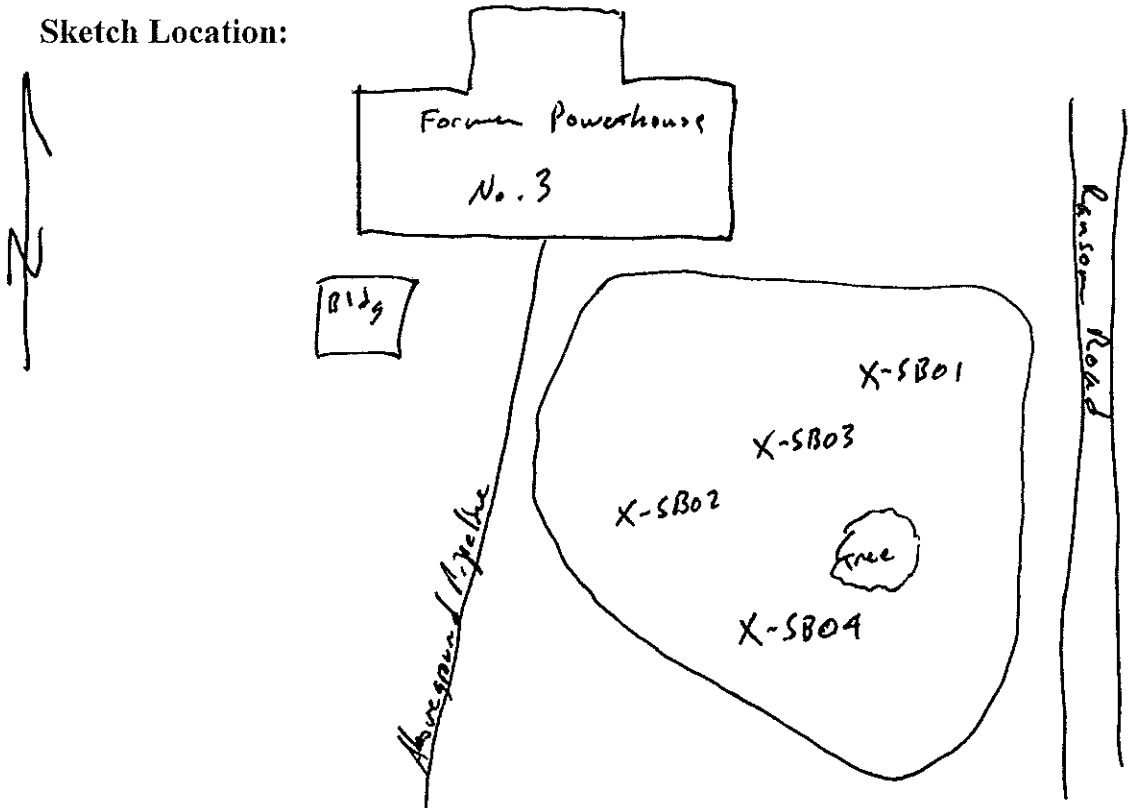
ERPIMS Values:

Sacode:

Lot Control#:

Comments: Also collected FD (CY0033) and FS (CY0034) at this location.

Sketch Location:



Logged BY / Date: E.W. Weaver 12-19-11 *Reviewed BY / Date:* Edward K. Mean 1-26-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB 122111 ACCT

Location Code: CY3-SB01-EW

Sample Number: CY0033

Sample Name: PB11-DS-CY3-SB01-CY0033-(3-5)-FD

Sampling Method: SS

Sample Type: DS *Sample Purpose:* FD

Sampling Equip: Stainless Steel bucket auger

QC Partners:

(TB) (ER) (FB)

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1119

Start Depth: 3'

End Depth: 5'

Sample Matrix: SOIL

Sample Team: EW/KB

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

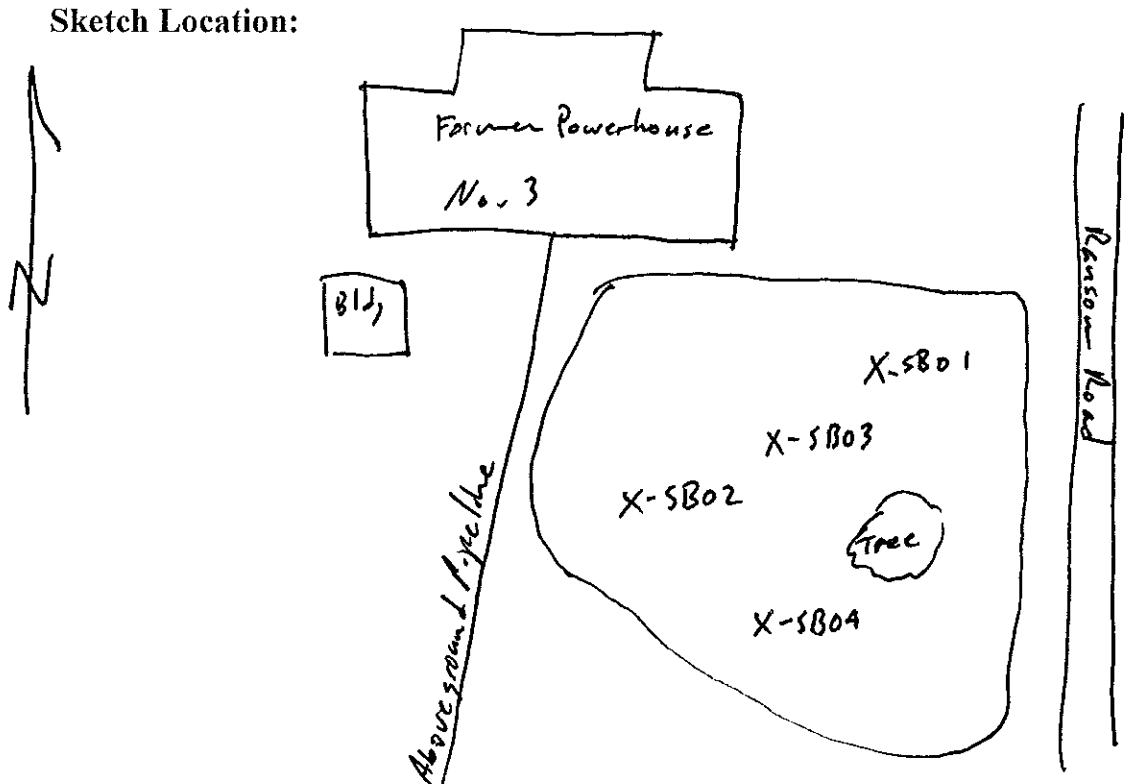
ERPIMS Values:

Sacode:

Lot Control#:

Comments: Also collected regular sample (CY0032) and FS (CY0034) at this location.

Sketch Location:



Logged BY / Date: E W Werner 12-19-11 *Reviewed BY / Date:* Edward E Werner 1-26-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111 ~~[illegible]~~ EW TA

Location Code: CY3-SB01

Sample Number: CY0034

Sample Name: PB11-DS-CY3-SB01-CY0034-(3-5)-FS

Sampling Method: SS

Sample Type: DS *Sample Purpose:* FS

Sampling Equip: Stainless Steel bucket auger

QC Partners:

(TB) (ER) (FB)

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1119

Start Depth: 3'

End Depth: 5'

Sample Matrix: SOIL

Sample Team: EW/KB

ERPIMS Values:

Sacode:

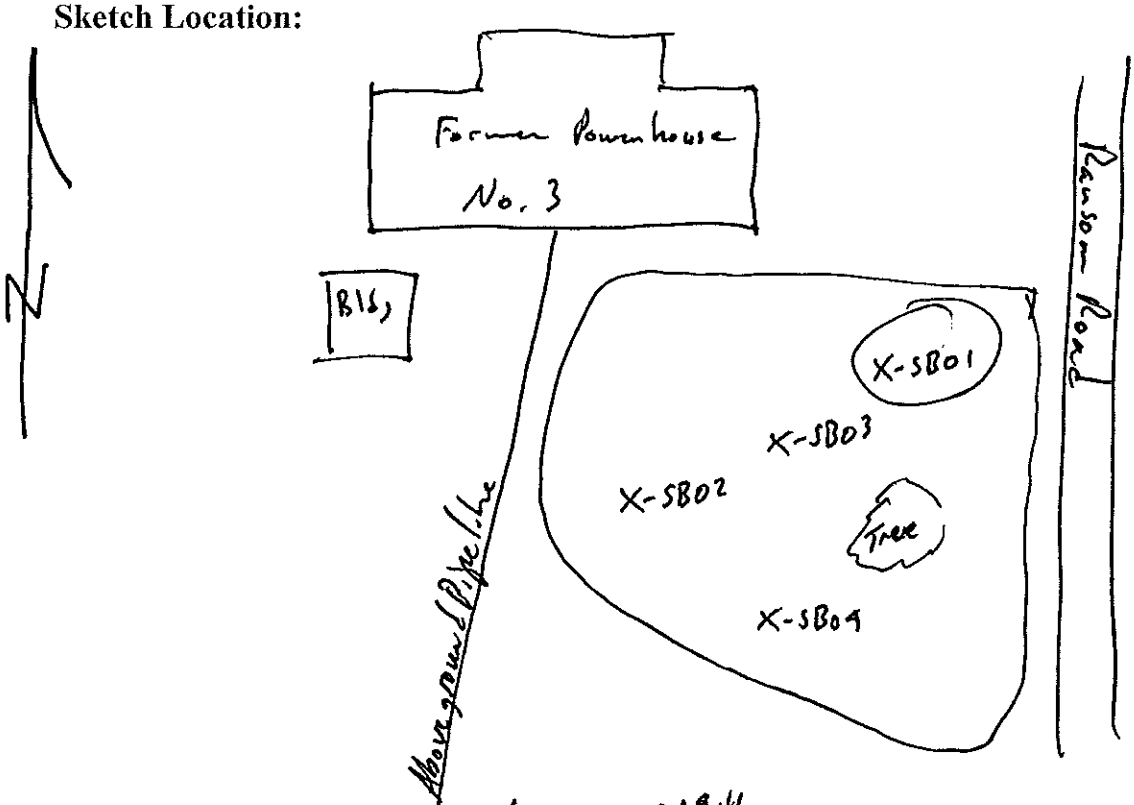
Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	1	4	oz	CWM
METALS3	N	B	1	8	oz	CWM
PCB3	N	B	1	8	oz	CWM
SEMIVOLATILES3	N	B	1	8	oz	CWM

Comments: Also collected regular sample (CY0032) and FD (CY0033) at this location.

Sketch Location:



Logged BY / Date: E. W. Weaver 12-19-11

Reviewed BY / Date: Edward E. Mason 1-26-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111ACCT

Location Code: CY3-SB0~~1~~ EW
Sample Number: CY0035
Sample Name: PB11-DS-CY3-SB0~~1~~ EW-CY0035-(8-10)-REG
Sampling Method: SS
Sample Type: DS *Sample Purpose:* REG
Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: 1140
Start Depth: 8'
End Depth: 10'
Sample Matrix: SOIL
Sample Team: EW/KB

QC Partners:
(TB) (ER) (FB)

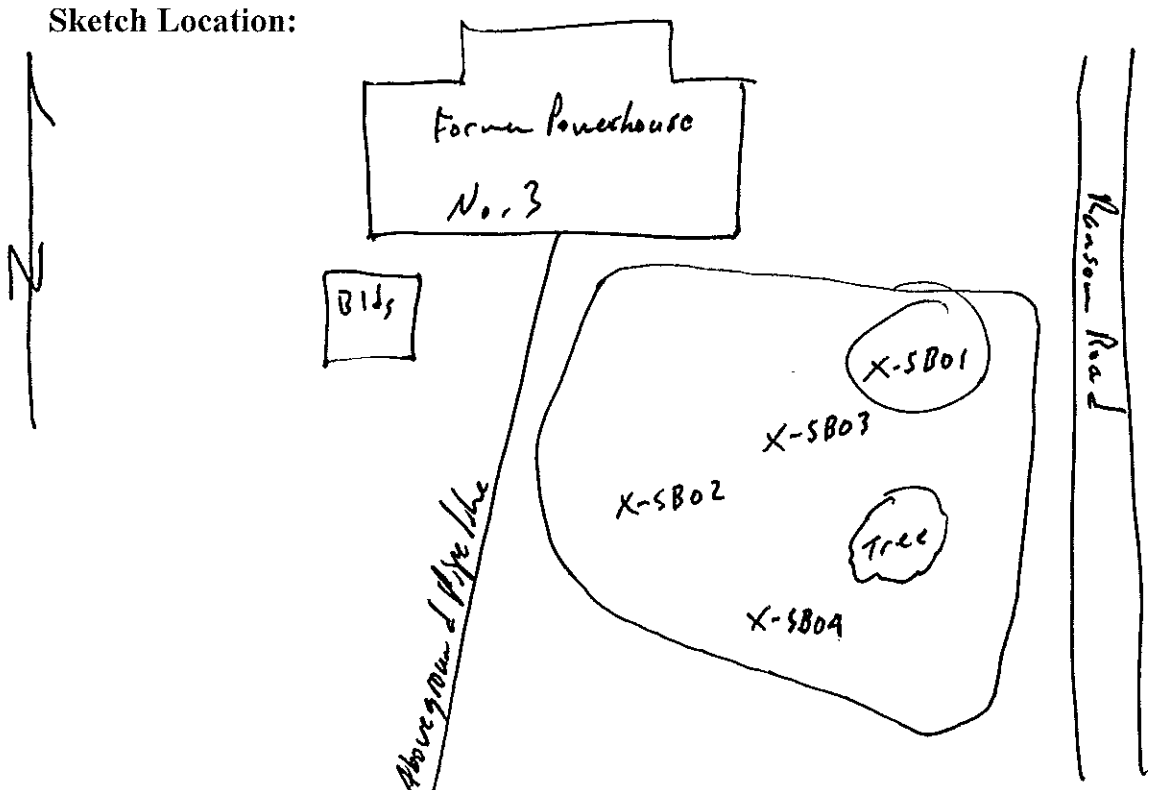
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E. W. Weaver 12-19-11 *Reviewed BY / Date:* Edward C. Nelson 1-26-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111ACCT

Location Code: CY3-SB~~1~~2
Sample Number: CY0036
Sample Name: PB11-SS-CY3-SB~~1~~2-CY0036-(0-1)-REG
Sampling Method: HA
Sample Type: SS *Sample Purpose:* REG
Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: ~~1240~~ 1250
Start Depth: ~~0~~ 1.5'
End Depth: ~~1~~ 2.5'
Sample Matrix: SOIL
Sample Team: OW/KB

QC Partners:
(TB) (ER) (FB)

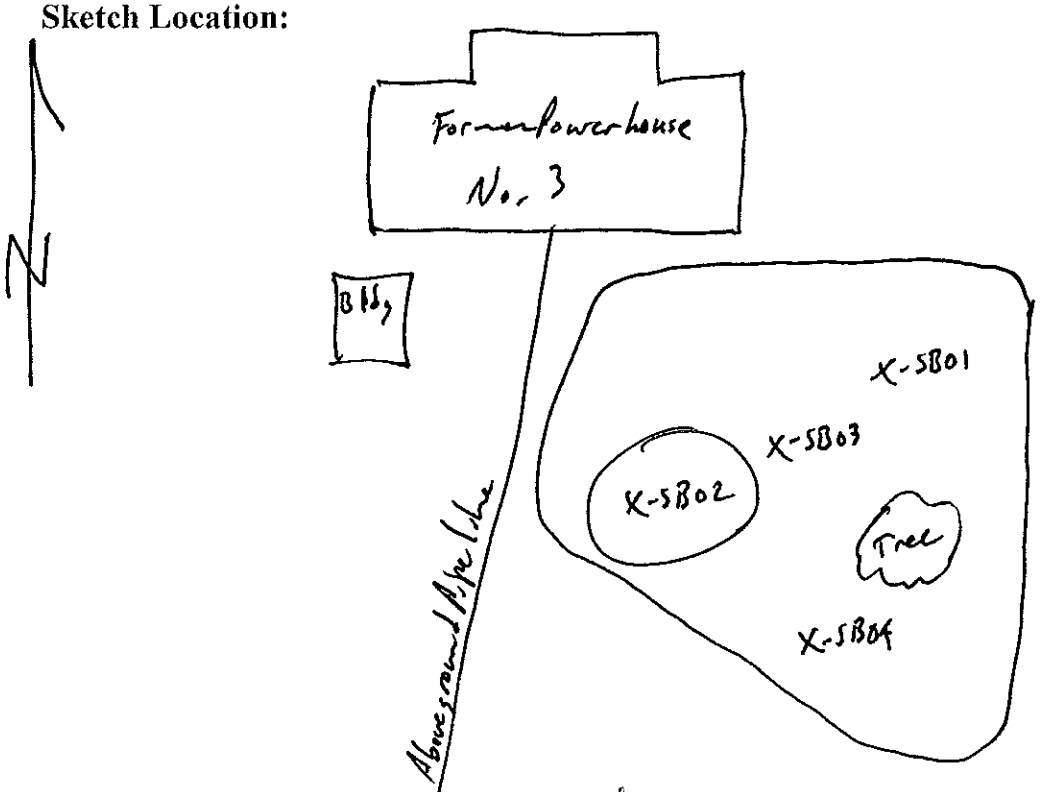
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: 12/19-11 *Reviewed BY / Date:* 1-26-12

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Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111 ACCT

Location Code: CY3-SB~~1~~2 GW

Sample Number: CY0037

Sample Name: PB11-DS-CY3-SB~~1~~2-CY0037-(3-5)-REG GW

Sampling Method: SS

Sample Type: DS *Sample Purpose:* REG

Sampling Equip: Stainless Steel bucket auger

QC Partners:

(TB) (ER) (FB)

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1310

Start Depth: 3'

End Depth: 5'

Sample Matrix: SOIL

Sample Team: GW/KB

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

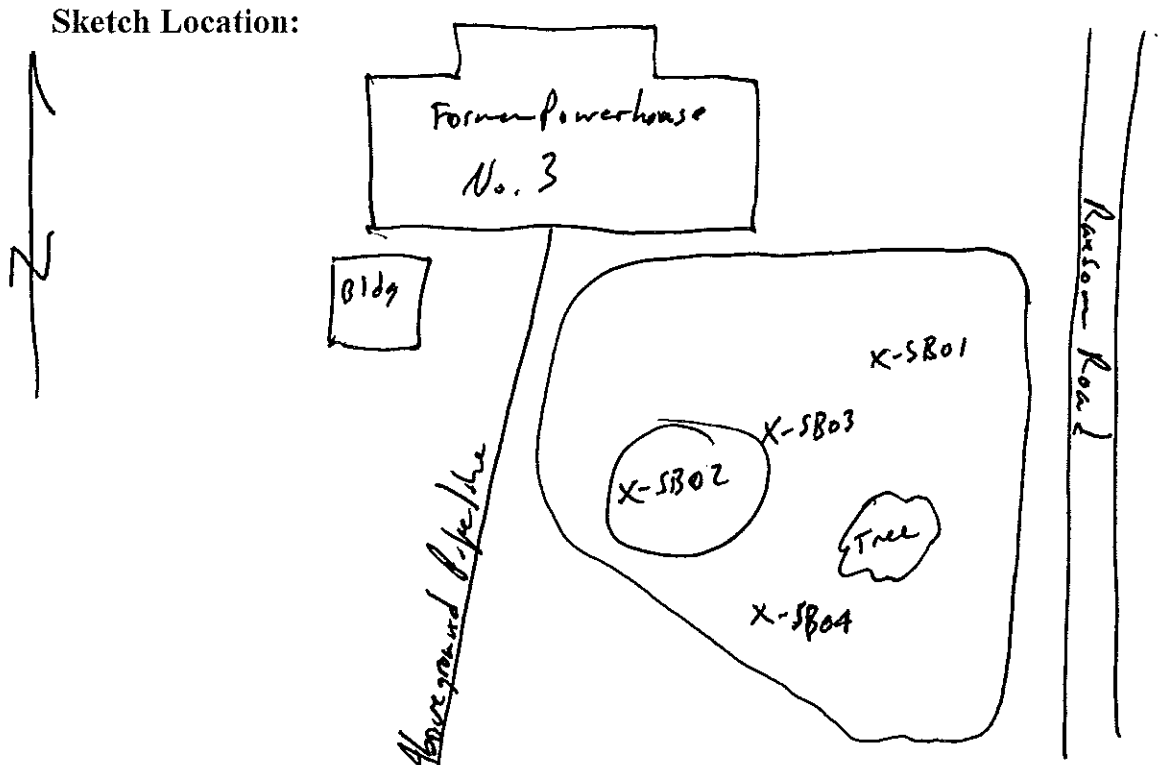
ERPIMS Values:

Sacode:

Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: L. W. Weaver 12/19-11 *Reviewed BY / Date:* Edward Kowalczyk 1-26-12

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Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111 ACCT

Location Code: CY3-SB~~1~~2
Sample Number: CY0038
Sample Name: PB11-DS-CY3-SB~~1~~2-CY0038-(8-10)-REG
Sampling Method: SS
Sample Type: DS *Sample Purpose:* REG
Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: 1330
Start Depth: 8'
End Depth: 10'
Sample Matrix: SOIL
Sample Team: EW/KB

QC Partners:
(TB) (ER) (FB)

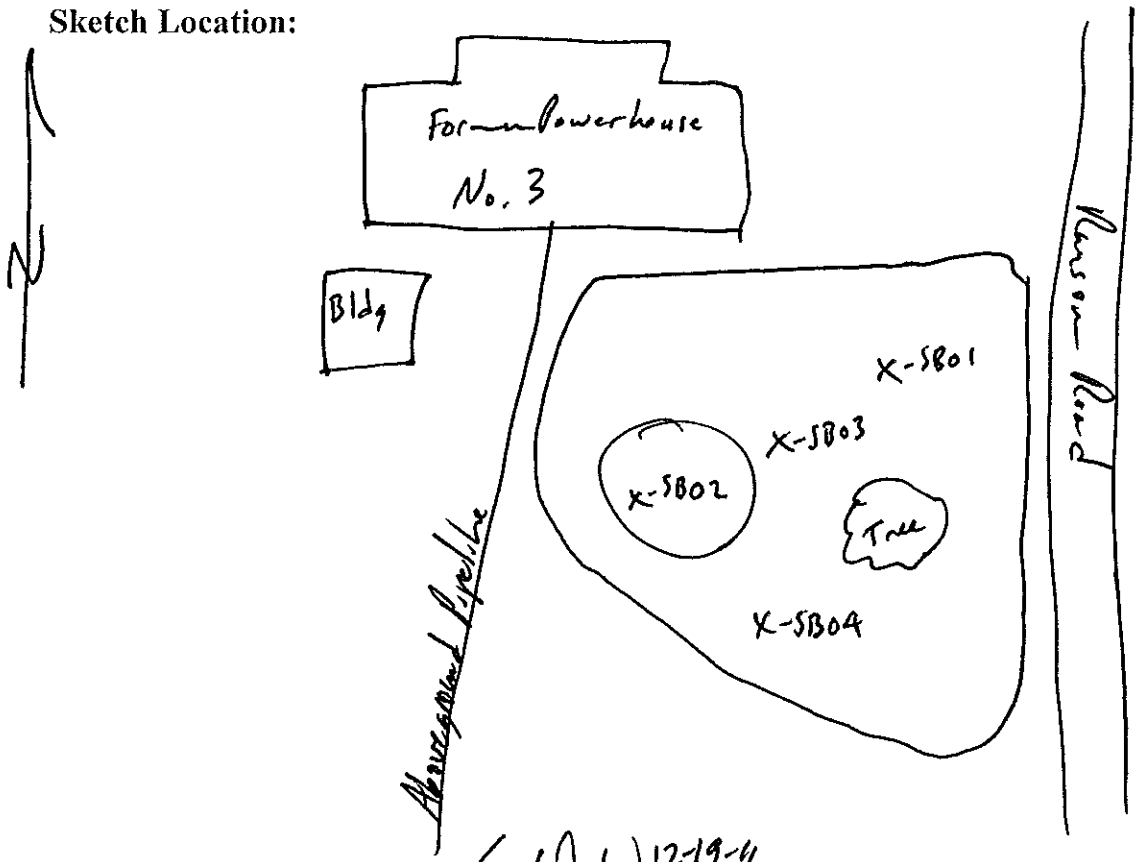
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E. W. Weaver 12-19-11 *Reviewed BY / Date:* Edward S. Weaver 1-26-12

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Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111 ACCT

Location Code: CY3-SB03

Sample Number: CY0039

Sample Name: PB11-SS-CY3-SB03-CY0039-(0-1)-REG

Sampling Method: HA

Sample Type: SS

Sample Purpose: REG

Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1540

Start Depth: 0

End Depth: 1'

Sample Matrix: SOIL

Sample Team: EW/KB/JB

QC Partners:

(TB) _____ (ER) _____ (FB) _____

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

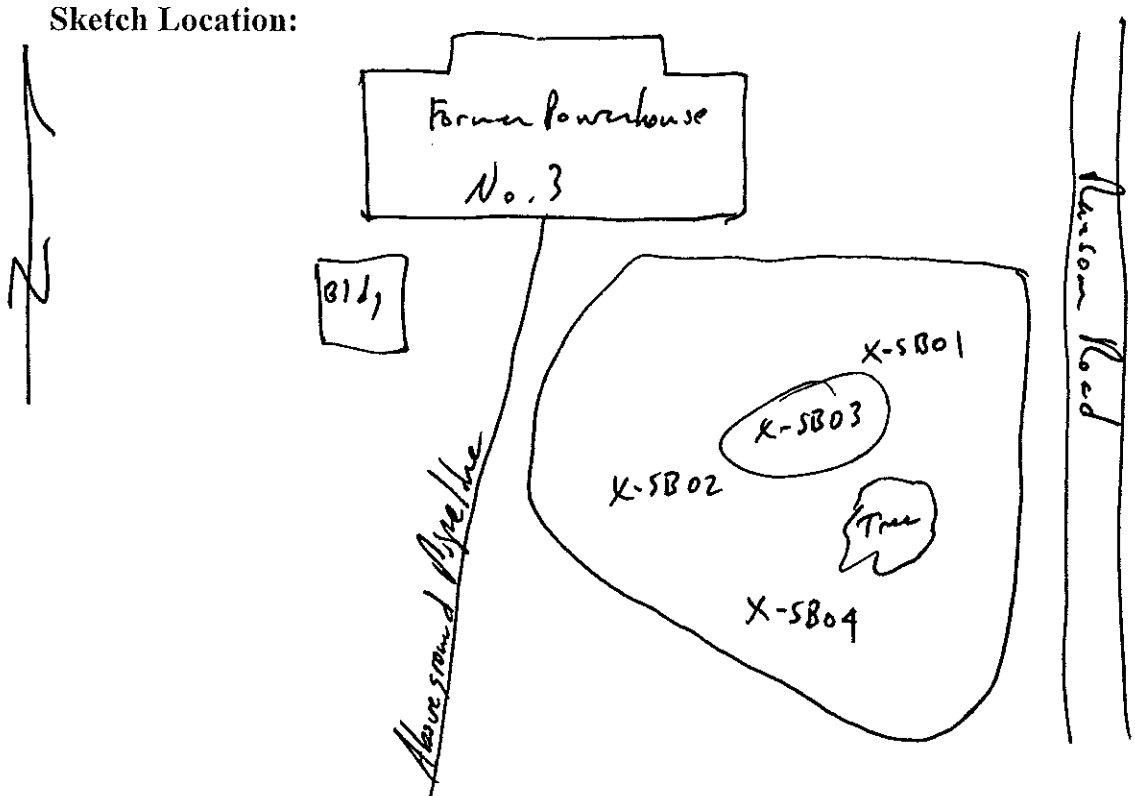
ERPIMS Values:

Sacode:

Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E. W. Weaver 12-19-11

Reviewed BY / Date: Edward Weaver 1-26-12

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Sample Collection Log

132457 PLUM BROOK ORDNANCE WKS
Manager: Steve Downey

RFA / COC Number: PB122111 ACCT

Location Code: CY3-SB03
Sample Number: CY0040
Sample Name: PB11-DS-CY3-SB03-CY0040-(3-5)-REG
Sampling Method: SS
Sample Type: DS *Sample Purpose:* REG
Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: 1545
Start Depth: 3'
End Depth: 5'
Sample Matrix: SOIL
Sample Team: GW/KB/JB

QC Partners:
(TB) (ER) (FB)

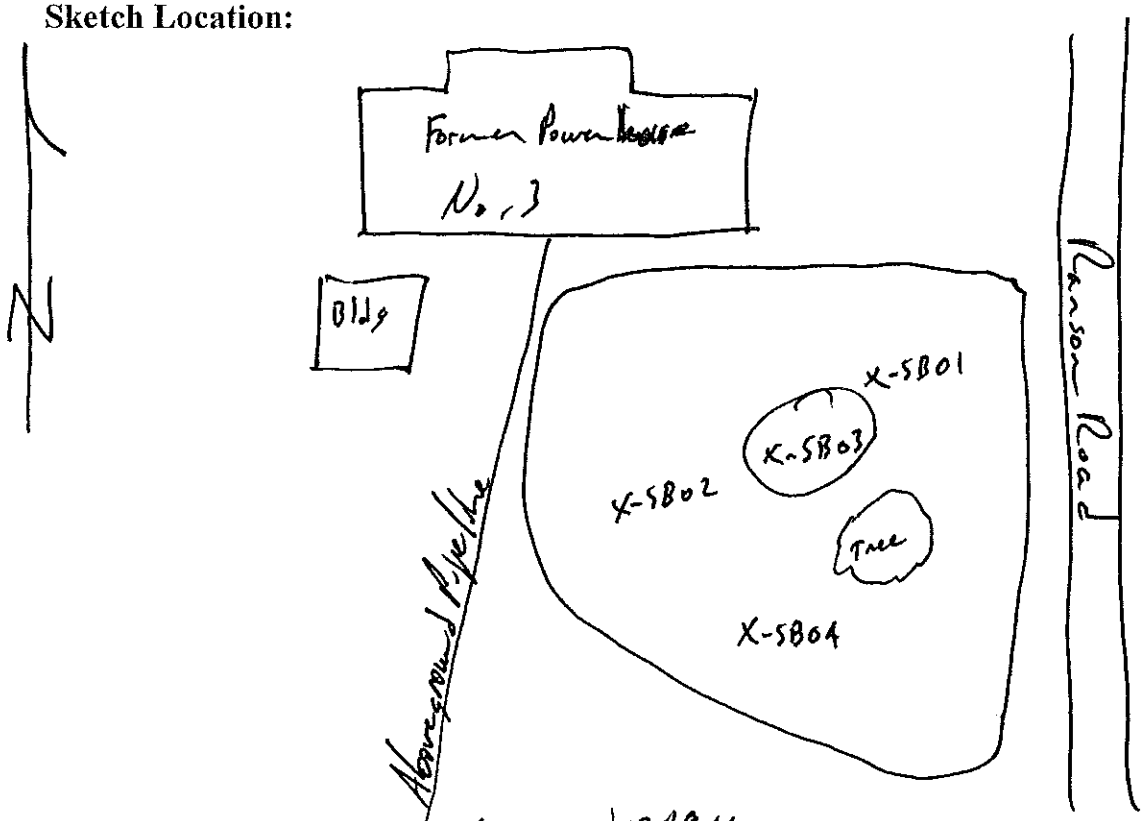
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments: Also collected MS (CY0040-MS) and MSD (CY0040-MSD) at this location.

Sketch Location:



Logged BY / Date: G.W. Weaver 121911 *Reviewed BY / Date:* Edward S. Maas 1-26-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111ACCT

Location Code: CY3-SB~~1~~03
Sample Number: CY0040MS
Sample Name: PB11-DS-CY3-SB~~1~~03-CY0040MS-(3-5)-MS
Sampling Method: SS
Sample Type: DS *Sample Purpose:* MS
Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: 1545
Start Depth: 3'
End Depth: 5'
Sample Matrix: SOIL

QC Partners:
(TB) (ER) (FB)

Sample Team: EW/KB/JB

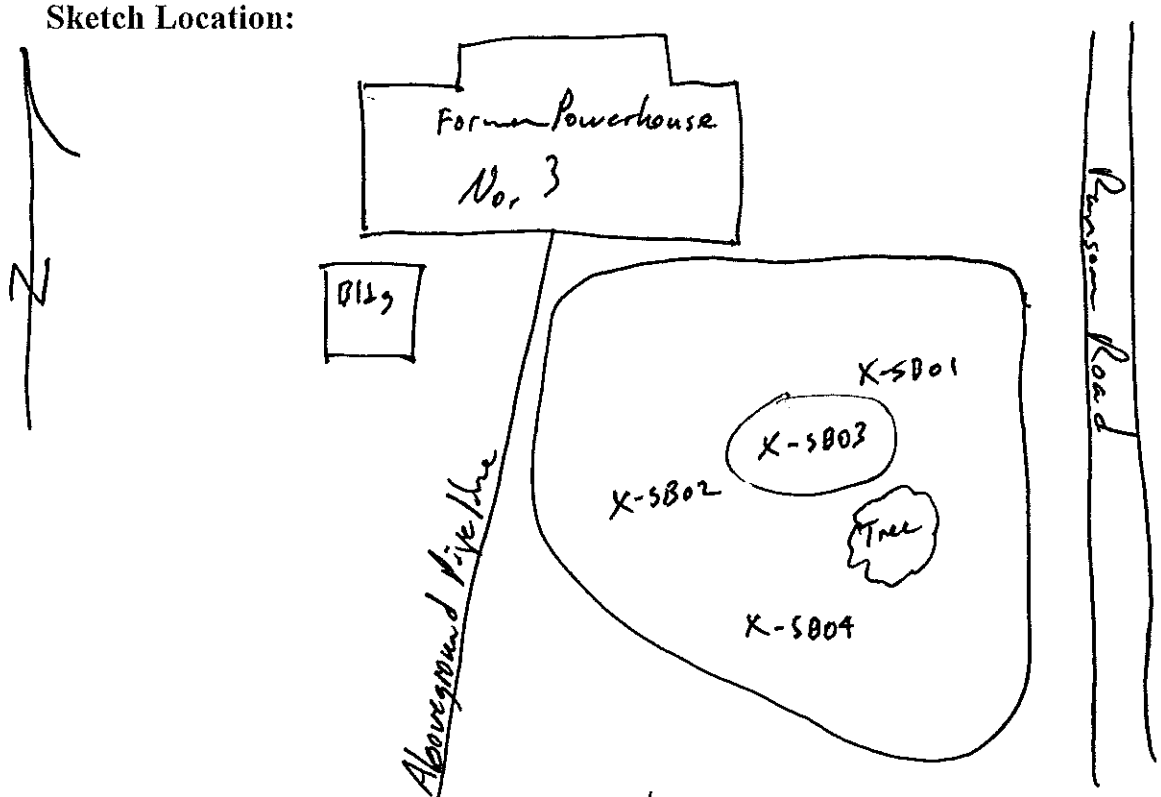
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments: Also collected regular sample (CY0040) and MSD (CY0040-MSD) at this location.

Sketch Location:



Logged BY / Date: E. W. Weaver 12-19-11 *Reviewed BY / Date:* Edward B. Weaver 1-26-12

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Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122711 ACCT

Location Code: CY3-SB~~B~~03 GW
Sample Number: CY0040MSD
Sample Name: PB11-DS-CY3-SB~~B~~03-CY0040MSD-(3-5)-MSD GW
Sampling Method: SS
Sample Type: DS *Sample Purpose:* MSD
Sampling Equip: Stainless Steel Bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: 1545
Start Depth: 3'
End Depth: 5'
Sample Matrix: SOIL
Sample Team: EW/KB/JB

QC Partners:
(TB) (ER) (FB)

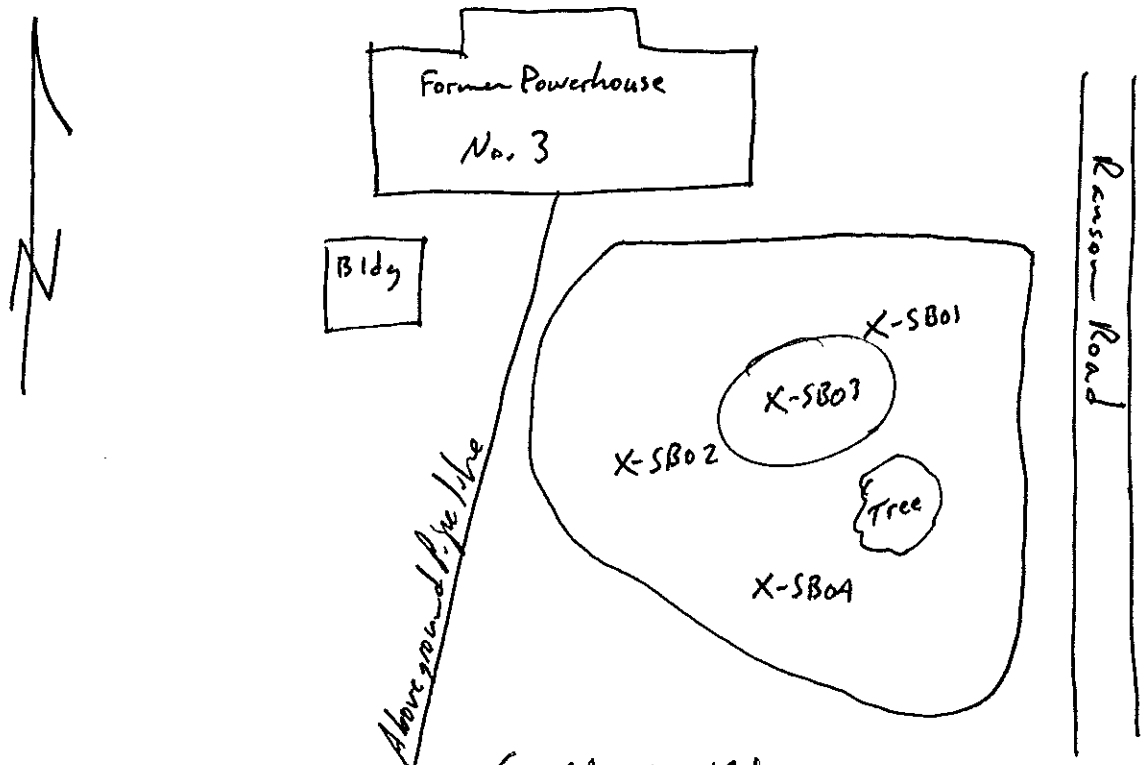
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments: Also collected regular sample (CY0040) and MS (CY0040-MS) at this location.

Sketch Location:



Logged BY / Date: E. W. Wenzel 12-19-11 *Reviewed BY / Date:* Edward E. Klein 1-26-12

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Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111ACCT

Location Code: CY3-SB03
Sample Number: CY0041
Sample Name: PB11-DS-CY3-SB03-CY0041-(8-10)-REG
Sampling Method: SS
Sample Type: DS *Sample Purpose:* REG
Sampling Equip: Stainless Steel bucket auger

Task: GMA_OCT2011
Collection Date: 12-19-11
Collection Time: 1555
Start Depth: 8'
End Depth: 10'
Sample Matrix: SOIL
Sample Team: EW/KB/JB

QC Partners:
(TB) (ER) (FB)

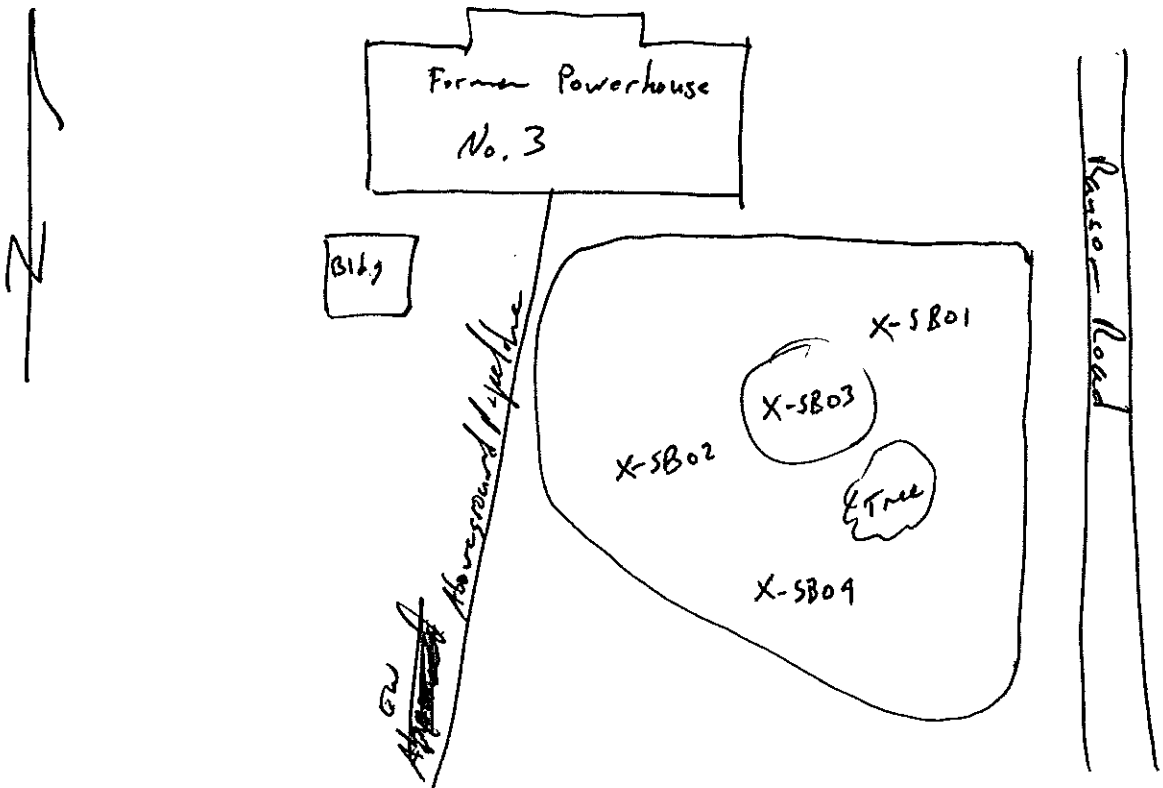
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

ERPIMS Values:
Sacode:
Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E. W. Wilson 12-19-11 *Reviewed BY / Date:* Edward Schlow 1-26-12

Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111 ACCT

Location Code: CY3-SB04 EW

Sample Number: CY0042

Sample Name: PB11-SS-CY3-SB04 EW-CY0042-(0-1)-REG

Sampling Method: HA

Sample Type: SS *Sample Purpose:* REG

Sampling Equip: Stainless Steel bucket auger

QC Partners:

(TB) (ER) (FB)

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1600

Start Depth: 0'

End Depth: 1'

Sample Matrix: SOIL

Sample Team: EW/KB/JB

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

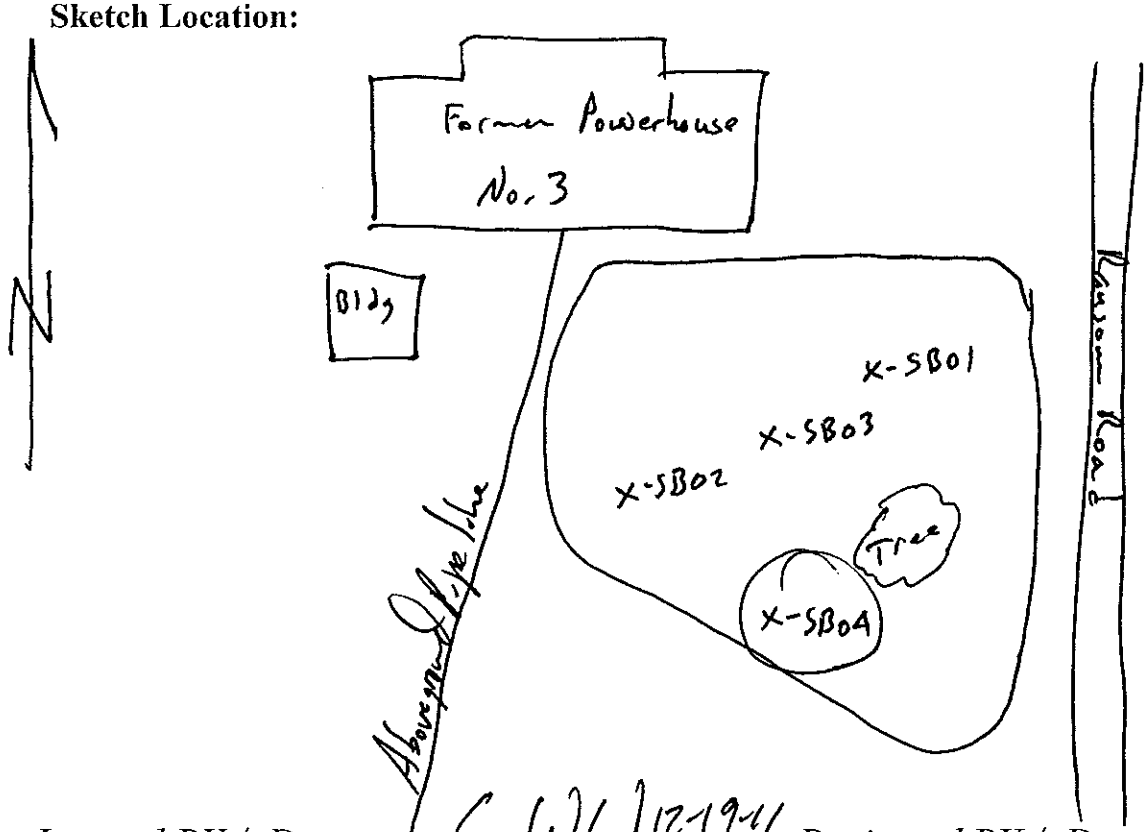
ERPIMS Values:

Sacode:

Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E. W. Weaver 12-19-11 *Reviewed BY / Date:* Edward S. Weaver 1-26-12

Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111ACCT

Location Code: CY3-SB~~02~~ 04 EW

Sample Number: CY0043

Sample Name: PB11-DS-CY3-SB~~02~~ 04 EW-CY0043-(3-5)-REG

Sampling Method: SS

Sample Type: DS *Sample Purpose:* REG

Sampling Equip: Stainless Steel bucket auger

QC Partners:

(TB) (ER) (FB)

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1610

Start Depth: 3'

End Depth: 5'

Sample Matrix: SOIL

Sample Team: EW/KB/JB

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
PCB3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

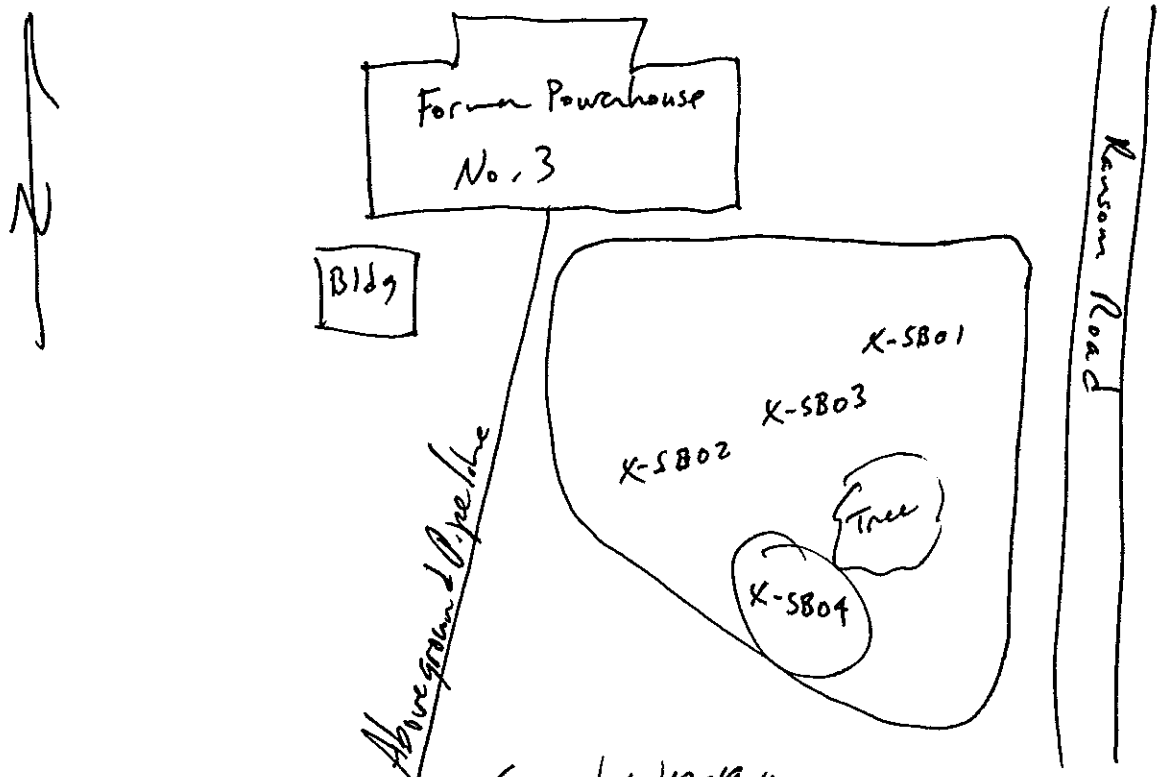
ERPIMS Values:

Sacode:

Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E. W. Weaver 12-19-11 *Reviewed BY / Date:* Edward W. Weaver 1-26-12

Shaw E & I, Inc.

Sample Collection Log

132457 - PLUM BROOK ORDNANCE WKS

Manager: Steve Downey

RFA / COC Number: PB122111 Acct

Location Code: CY3-SB~~1~~04 EW

Sample Number: CY0044

Sample Name: PB11-DS-CY3-SB~~1~~04 EW-CY0044-(8-10)-REG

Sampling Method: SS

Sample Type: DS *Sample Purpose:* REG

Sampling Equip: Stainless Steel bucket auger

QC Partners:

(TB) (ER) (FB)

Task: GMA_OCT2011

Collection Date: 12-19-11

Collection Time: 1630

Start Depth: 8'

End Depth: 10'

Sample Matrix: SOIL

Sample Team: EW/KB/JB

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	8	oz	CWM
METALS3	N	A	2	8	oz	CWM
SEMIVOLATILES3	N	A	2	8	oz	CWM

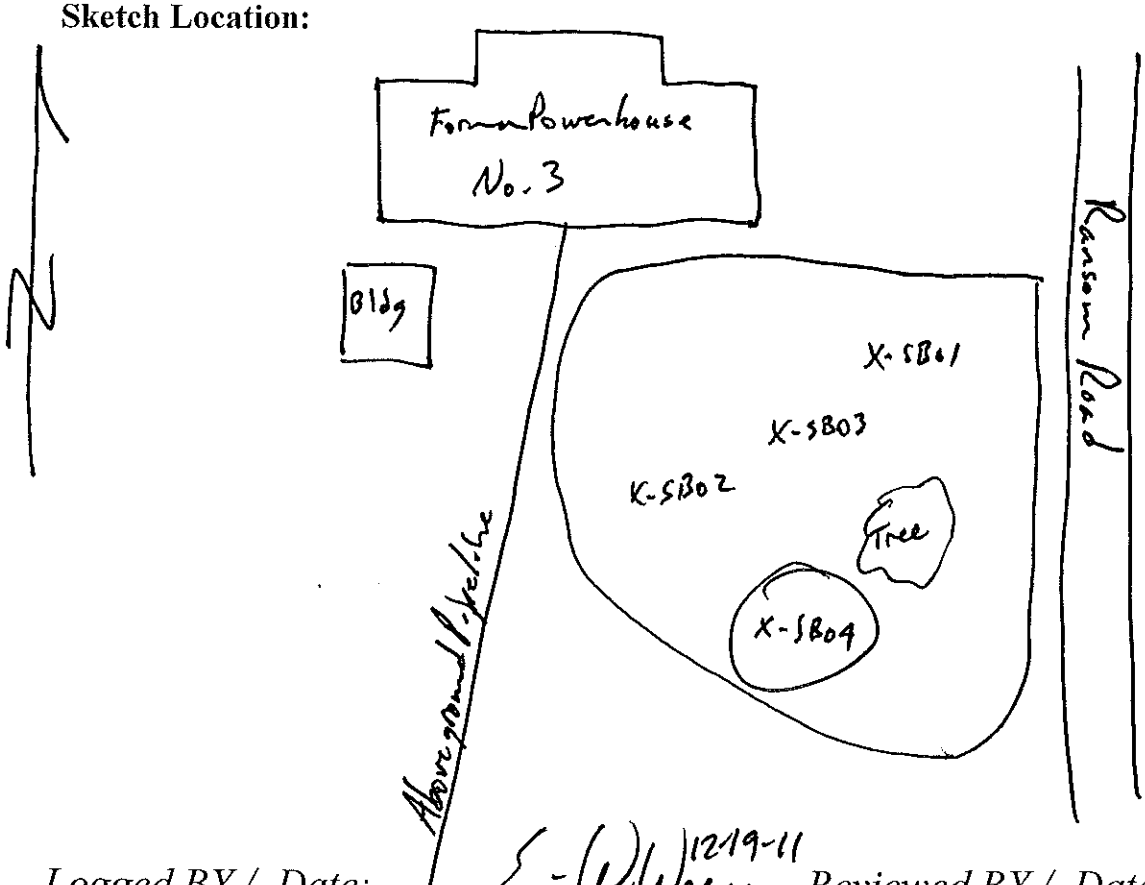
ERPIMS Values:

Sacode:

Lot Control#:

Comments:

Sketch Location:



Logged BY / Date: E-W Weaver 12/19-11 *Reviewed BY / Date:* Edward Sullivan 1-26-12

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Shaw E & I, Inc.

Sample Collection Log

119268 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB122011ACCT

Location Code: AP3-MW01
Sample Number: AP3083
Sample Name: PBOW11-GW-AP3-MW01-AP3083-REG
Sampling Method: PP
Sample Type: GW *Sample Purpose:* REG
Sampling Equip: Bladder pump, teflon lined tubing, bottles

Task: NOV2011_AP3
Collection Date: 12-19-11
Collection Time: 1110
Start Depth: ~~12.50'~~ 1.30'
End Depth: 1.30'
Sample Matrix: WATER
Sample Team: EW/JB

QC Partners:
(TB) (ER) (FB)

ERPIMS Values:
Sacode:
Lot Control#:

Containers

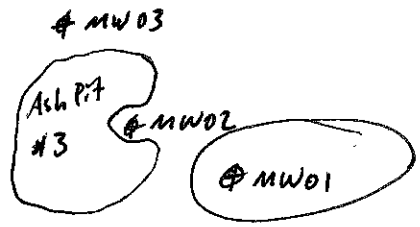
Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	1	L	Amb. Glass
SEMIVOLATILES3	N	B	2	1	L	Amb. Glass
METALS3-W-F	Y	C	1	500	mL	HDPE
HARDNESS	N	D	1	500	mL	HDPE
METALS3-W	N	D	1	500	mL	HDPE
ALKALINITY	N	E	1	1	L	HDPE
CHLORIDE	N	E	1	1	L	HDPE
SULFATE	N	E	1	1	L	HDPE
TDS	N	E	1	1	L	HDPE
TSS	N	E	1	1	L	HDPE
TURB 180.1	N	E	1	1	L	HDPE
CYANIDE	N	G	1	500	mL	HDPE
NO2/NO3	N	H	1	500	mL	HDPE
VOLATILES	N	I	3	40	mL	VOA VIAL

Groundwater Information:

Measured Well Depth: 20.29' Depth To Water: 1.18'

Comments: Also collected MS (AP3083MS), MSD (AP3083MSD), FD (AP3084), FS (AP3085) at this location.
Ferrous Iron 0.0 mg/L

Sketch Location:



N

Logged BY / Date: E. W. Weaver 12-19-11 Reviewed BY / Date: Edward G. Nowak 1-12-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

119268 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB122011ACCT

Location Code: **AP3-MW01**
Sample Number: **AP3083-MS**
Sample Name: **PBOW11-GW-AP3-MW01-AP3083-MS**
Sampling Method: **PP**
Sample Type: **GW** *Sample Purpose:* **MS**
Sampling Equip: Bladder pump, teflon lined tubing, bottles

Task: **NOV2011_AP3**
Collection Date: 12-19-11
Collection Time: 1110
Start Depth: 1.30'
End Depth: 1.30'
Sample Matrix: **WATER**
Sample Team: EW/JB

QC Partners:
(TB) (ER) (FB)

ERPIMS Values:
Sacode:
Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	1	L	Amb. Glass
SEMIVOLATILES3	N	B	2	1	L	Amb. Glass
METALS3-W-F	Y	C	1	500	mL	HDPE
HARDNESS	N	D	1	500	mL	HDPE
METALS3-W	N	D	1	500	mL	HDPE
ALKALINITY	N	E	1	1	L	HDPE
CHLORIDE	N	E	1	1	L	HDPE
SULFATE	N	E	1	1	L	HDPE
TDS	N	E	1	1	L	HDPE
TSS	N	E	1	1	L	HDPE
TURB 180.1	N	E	1	1	L	HDPE
CYANIDE	N	G	1	500	mL	HDPE
NO2/NO3	N	H	1	500	mL	HDPE
VOLATILES	N	I	3	40	mL	VOA VIAL

Groundwater Information:
Measured Well Depth: 20.29' **Depth To Water:** 1.18'

Comments: Also collected regular sample (AP3083), MSD (AP3083MSD), FD (AP3084), FS (AP3085) at this location.

Sketch Location:

Logged BY / Date: E. W. Weaver 12-19-11 *Reviewed BY / Date:* Edward Weaver 1-12-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

119268 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB122011 ACCT

Location Code: **AP3-MW01**
Sample Number: **AP3083-MSD**
Sample Name: **PBOW11-GW-AP3-MW01-AP3083-MSD**
Sampling Method: **PP**
Sample Type: **GW** *Sample Purpose:* **MSD**
Sampling Equip: Bladder pump, teflon lined tubing, bottles

Task: **NOV2011_AP3**
Collection Date: 12-19-11
Collection Time: 1110
Start Depth: 1.30'
End Depth: 1.30'
Sample Matrix: **WATER**
Sample Team: EW/JB

QC Partners:
(TB) (ER) (FB)

ERPIMS Values:
Sacode:
Lot Control#:

Containers

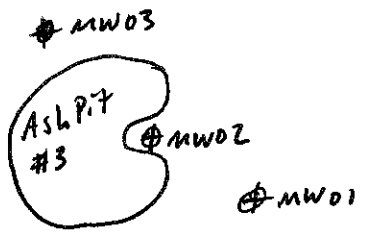
Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	1	L	Amb. Glass
SEMIVOLATILES3	N	B	2	1	L	Amb. Glass
METALS3-W-F	Y	C	1	500	mL	HDPE
HARDNESS	N	D	1	500	mL	HDPE
METALS3-W	N	D	1	500	mL	HDPE
ALKALINITY	N	E	1	1	L	HDPE
CHLORIDE	N	E	1	1	L	HDPE
SULFATE	N	E	1	1	L	HDPE
TDS	N	E	1	1	L	HDPE
TSS	N	E	1	1	L	HDPE
TURB 180.1	N	E	1	1	L	HDPE
CYANIDE	N	G	1	500	mL	HDPE
NO2/NO3	N	H	1	500	mL	HDPE
VOLATILES	N	I	3	40	mL	VOA VIAL

Groundwater Information:

Measured Well Depth: 20.29' **Depth To Water:** 1.18'

Comments: Also collected regular sample (AP3083), MS (AP3083MS), FD (AP3084), FS (AP3085) at this location.

Sketch Location:



Logged BY / Date: Eric W. Weaver 12-19-11 *Reviewed BY / Date:* Edward M. Moore 1-12-12

Shaw
Shaw E & I, Inc.

Sample Collection Log

119268 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB122011ACCT

Location Code: **AP3-MW01**
Sample Number: **AP3084**
Sample Name: **PBOW11-GW-AP3-MW01-AP3084-FD**
Sampling Method: **PP**
Sample Type: **GW** *Sample Purpose:* **FD**
Sampling Equip: Bladder pumps, teflon lined tubing, bottles

Task: **NOV2011_AP3**
Collection Date: 12-19-11
Collection Time: 1110
Start Depth: 1.30'
End Depth: 1.30'
Sample Matrix: **WATER**
Sample Team: EW/JB

QC Partners:
(TB) (ER) (FB)

ERPIMS Values:
Sacode:
Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	1	L	Amb. Glass
SEMIVOLATILES3	N	B	2	1	L	Amb. Glass
METALS3-W-F	Y	C	1	500	mL	HDPE
HARDNESS	N	D	1	500	mL	HDPE
METALS3-W	N	D	1	500	mL	HDPE
ALKALINITY	N	E	1	1	L	HDPE
CHLORIDE	N	E	1	1	L	HDPE
SULFATE	N	E	1	1	L	HDPE
TDS	N	E	1	1	L	HDPE
TSS	N	E	1	1	L	HDPE
TURB 180.1	N	E	1	1	L	HDPE
CYANIDE	N	G	1	500	mL	HDPE
NO2/NO3	N	H	1	500	mL	HDPE
VOLATILES	N	I	3	40	mL	VOA VIAL

Groundwater Information:

Measured Well Depth: 20.29' **Depth To Water:** 1.18'

Comments: Also collected regular sample (AP3083), MS (AP3083MS), MSD (AP3083MSD), FS (AP3085) at this location.

Sketch Location:

Logged BY / Date: Eric W. Weaver 12-19-11 *Reviewed BY / Date:* Edward J. Wann 1-12-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

119268 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB122011 TA

Location Code: **AP3-MW01**
Sample Number: **AP3085**
Sample Name: **PBOW11-GW-AP3-MW01-AP3085-FS**
Sampling Method: **PP**
Sample Type: **GW** *Sample Purpose:* **FS**
Sampling Equip: Bladderpump, teflon lined tubing, bottles

Task: **NOV2011_AP3**
Collection Date: 12-19-11
Collection Time: 1110
Start Depth: 1.30'
End Depth: 1.30'
Sample Matrix: **WATER**
Sample Team: EW/JB

QC Partners:
(TB) _____ (ER) _____ (FB) _____

ERPIMS Values:
Sacode: _____
Lot Control#: _____

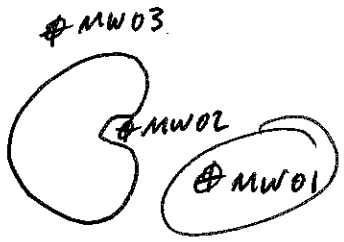
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	1	L	Amb. Glass
SEMIVOLATILES3	N	B	2	1	L	Amb. Glass
METALS3-W-F	Y	C	1	500	mL	HDPE
METALS3-W	N	D	1	500	mL	HDPE
ALKALINITY	N	E	1	1	L	HDPE
CHLORIDE	N	E	1	1	L	HDPE
SULFATE	N	E	1	1	L	HDPE
TDS	N	E	1	1	L	HDPE
TSS	N	E	1	1	L	HDPE
TURB 180.1	N	E	1	1	L	HDPE
CYANIDE	N	G	1	250	mL	HDPE
NO2/NO3	N	H	1	250	mL	HDPE
HARDNESS	N	I	1	250	mL	HDPE
VOLATILES	N	J	3	40	mL	VOA VIAL

Groundwater Information:
Measured Well Depth: 20.29' **Depth To Water:** 1.18'

Comments: Also collected regular sample (AP3083), MS (AP3083MS), MSD (AP3083MSD), FD (AP3084) at this location.

Sketch Location:



Logged BY / Date: Eric W. Weaver 12-19-11 *Reviewed BY / Date:* Edward G. Weaver 1-12-12

Shaw E & I, Inc.

Sample Collection Log

119263 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB121611ACCT

Location Code: AP3-MW02

Sample Number: AP3086

Sample Name: PBOW11-GW-AP3-MW02-AP3086-REG

Sampling Method: PP

Sample Type: GW *Sample Purpose:* REG

Sampling Equip: Bladder pump, teflon lined tubing, bottles

QC Partners:

(TB) (ER) (FB)

Task: NOV2011_AP3

Collection Date: 12-16-11

Collection Time: 0942

Start Depth: 10.02

End Depth: 10.19

Sample Matrix: WATER

Sample Team: EW/JB

ERPIMS Values:

Sacode:

Lot Control#:

Containers

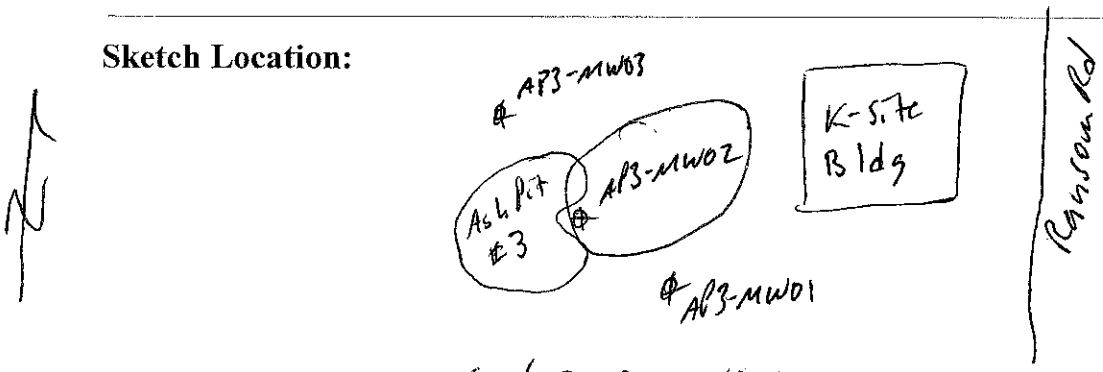
Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	1	L	Amb. Glass
SEMIVOLATILES3	N	B	2	1	L	Amb. Glass
METALS3-W-F	Y	C	1	500	mL	HDPE
HARDNESS	N	D	1	500	mL	HDPE
METALS3-W	N	D	1	500	mL	HDPE
ALKALINITY	N	E	1	1	L	HDPE
CHLORIDE	N	E	1	1	L	HDPE
SULFATE	N	E	1	1	L	HDPE
TDS	N	E	1	1	L	HDPE
TSS	N	E	1	1	L	HDPE
TURB 180.1	N	E	1	1	L	HDPE
CYANIDE	N	G	1	500	mL	HDPE
NO2/NO3	N	H	1	500	mL	HDPE
VOLATILES	N	I	3	40	mL	VOA VIAL

Groundwater Information:

Measured Well Depth: 24.85 Depth To Water: 6.39

Comments: Ferrous Iron - 0.0 mg/L

Sketch Location:



Logged BY / Date: 12-16-11 Reviewed BY / Date: 1-12-12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

119268 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB122011ACCT

Location Code: **AP3-MW03**
Sample Number: **AP3087**
Sample Name: **PBOW11-GW-AP3-MW03-AP3087-REG**
Sampling Method: **PP**
Sample Type: **GW** *Sample Purpose:* **REG**
Sampling Equip: Bladderpump, teflon lined tubing, bottles

Task: **NOV2011_AP3**
Collection Date: 12-20-11
Collection Time: 1045
Start Depth: 7.22'
End Depth: 7.41'
Sample Matrix: **WATER**
Sample Team: EW/JB

QC Partners:
(TB) (ER) (FB)

ERPIMS Values:
Sacode:
Lot Control#:

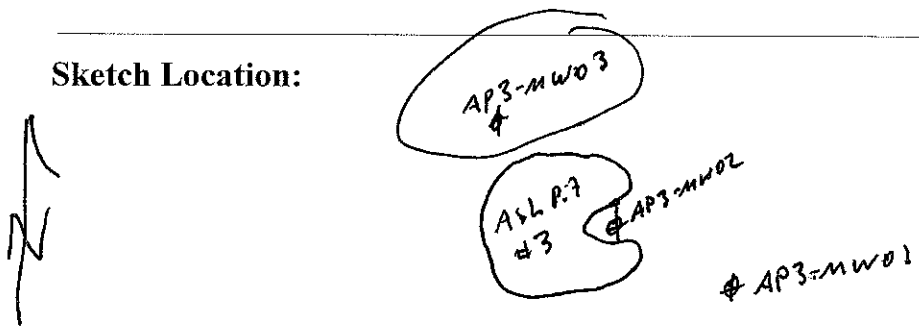
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	2	1	L	Amb. Glass
SEMIVOLATILES3	N	B	2	1	L	Amb. Glass
METALS3-W-F	Y	C	1	500	mL	HDPE
HARDNESS	N	D	1	500	mL	HDPE
METALS3-W	N	D	1	500	mL	HDPE
ALKALINITY	N	E	1	1	L	HDPE
CHLORIDE	N	E	1	1	L	HDPE
SULFATE	N	E	1	1	L	HDPE
TDS	N	E	1	1	L	HDPE
TSS	N	E	1	1	L	HDPE
TURB 180.1	N	E	1	1	L	HDPE
CYANIDE	N	G	1	500	mL	HDPE
NO2/NO3	N	H	1	500	mL	HDPE
VOLATILES	N	I	3	40	mL	VOA-VIAL

Groundwater Information:
Measured Well Depth: 23.39' **Depth To Water:** 4.50'

Comments: Ferrous Iron 0.0 mg/L

Sketch Location:



Logged BY / Date: E. W. Wenner 12-20-11 *Reviewed BY / Date:* Edward Gallen 1-12-12

Shaw E & I, Inc.

Sample Collection Log

119268 · PLUM BROOK ORDNANCE WRK

Manager:

RFA / COC Number: PB053012ACCT

Location Code: **AP3-MW01**

Sample Number: **AP3088**

Sample Name: **PBOW12-GW-AP3-MW01-AP3088-REG**

Sampling Method: **BP**

Sample Type: **GW** *Sample Purpose:* **REG**

Sampling Equip: Snap Samplers

QC Partners:

(TB) **(ER)** **(FB)**

Task: **AP3_MW_SPRING2012**

Collection Date: 5-30-12

Collection Time: 1055

Start Depth: ~~3.74~~ EW

End Depth: –

Sample Matrix: **WATER**

Sample Team: JB/MG

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
EXPLOSIVES	N	A	~~2~~ EW 1	1	L	Amb. Glass
~~SEMIVOLATILES3~~	~~N~~	~~B~~	~~2~~	~~1~~	~~L~~	~~Amb. Glass~~ EW
~~METALS3-W-F~~	~~Y~~	~~C~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~ EW
~~HARDNESS~~	~~N~~	~~D~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~ EW
METALS3-W	N	D	1	500	mL	HDPE
~~ALKALINITY~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~ EW
~~CHLORIDE~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~ EW
~~SULFATE~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~ EW
~~TDS~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~ EW
~~TSS~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~ EW
~~TURB 180.1~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~ EW
VOLATILES	N	F	~~1~~ EW 2	40	mL	VOA VIAL
~~CYANIDE~~	~~N~~	~~G~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~ EW
~~NO2/NO3~~	~~N~~	~~H~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~ EW

ERPIMS Values:

Sacode:

Lot Control#:

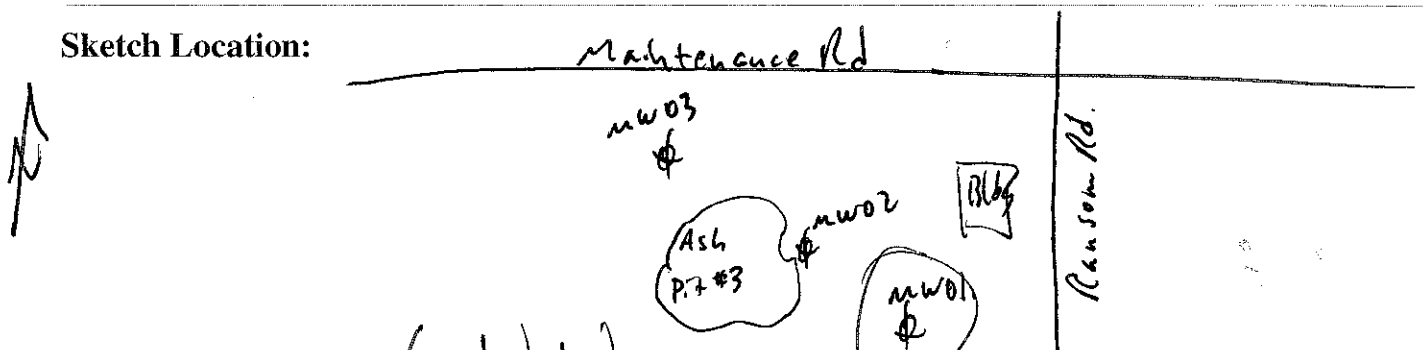
Groundwater Information:

Measured Well Depth: –

Depth To Water: 3.74'

Comments:

Sketch Location:



Logged BY / Date: E. W. Werner

Reviewed BY / Date: Edward E. Wilson 6/12/12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

119268 - PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB053012ACCT

Location Code: **AP3-MW02**
Sample Number: **AP3091**
Sample Name: **PBOW12-GW-AP3-MW02-AP3091-REG**
Sampling Method: **BP**
Sample Type: **GW** *Sample Purpose:* **REG**
Sampling Equip: Snap Sampler

Task: **AP3_MW_SPRING2012**
Collection Date: 5-30-12
Collection Time: 1105
Start Depth: —
End Depth: —
Sample Matrix: **WATER**
Sample Team: MG/JB

QC Partners:
(TB) (ER) (FB) —

ERPIMS Values:
Sacode:
Lot Control#:

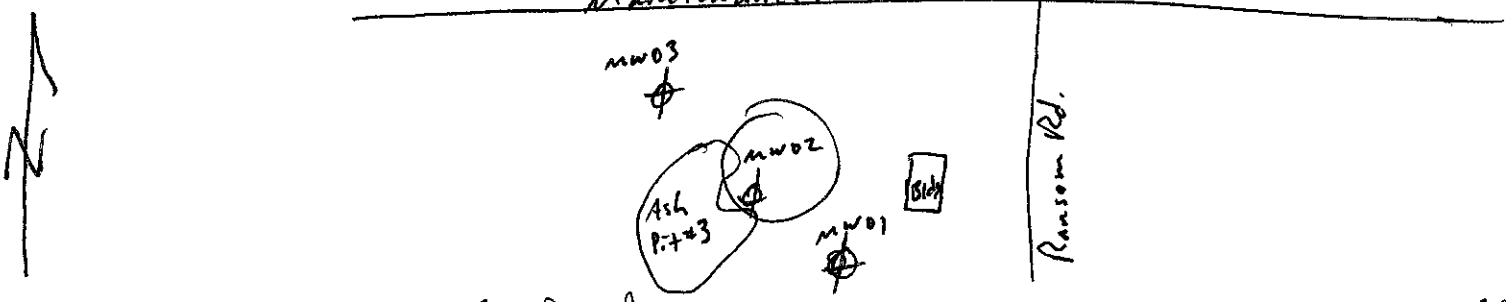
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type	
EXPLOSIVES	N	A	~~1~~ 2 EW	1	L	Amb. Glass	
~~SEMIVOLATILES3~~	~~N~~	~~B~~	~~2~~	~~1~~	~~L~~	~~Amb. Glass~~	EW
~~METALS3-W-F~~	~~Y~~	~~C~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW
~~HARDNESS~~	~~N~~	~~D~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW
METALS3-W	N	D	1	500	mL	HDPE	
~~ALKALINITY~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~CHLORIDE~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~SULFATE~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~TDS~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~TSS~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~TURB 180.1~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	HDPE	EW
VOLATILES	N	F	~~1~~ 2 EW	40	mL	VOA VIAL	
~~CYANIDE~~	~~N~~	~~G~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW
~~NO2/NO3~~	~~N~~	~~H~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW

Groundwater Information:
Measured Well Depth: — **Depth To Water:** 7.14

Comments:

Sketch Location: Maintenance Rd



Logged BY / Date: E. W. Weaver 5-30-12 *Reviewed BY / Date:* [illegible] 6/12/12

Shaw™
Shaw E & I, Inc.

Sample Collection Log

119268 · PLUM BROOK ORDNANCE WRKS

Manager:

RFA / COC Number: PB053012ACCT

Location Code: **AP3-MW03**
Sample Number: **AP3092**
Sample Name: **PBOW12-GW-AP3-MW03-AP3092-REG**
Sampling Method: **BP**
Sample Type: **GW** *Sample Purpose:* **REG**
Sampling Equip: Snap Sampler

Task: **AP3_MW_SPRING2012**
Collection Date: 5-30-12
Collection Time: 1115
Start Depth: —
End Depth: —
Sample Matrix: **WATER**
Sample Team: MG/JB

QC Partners:
(TB) — (ER) — (FB) —

Containers

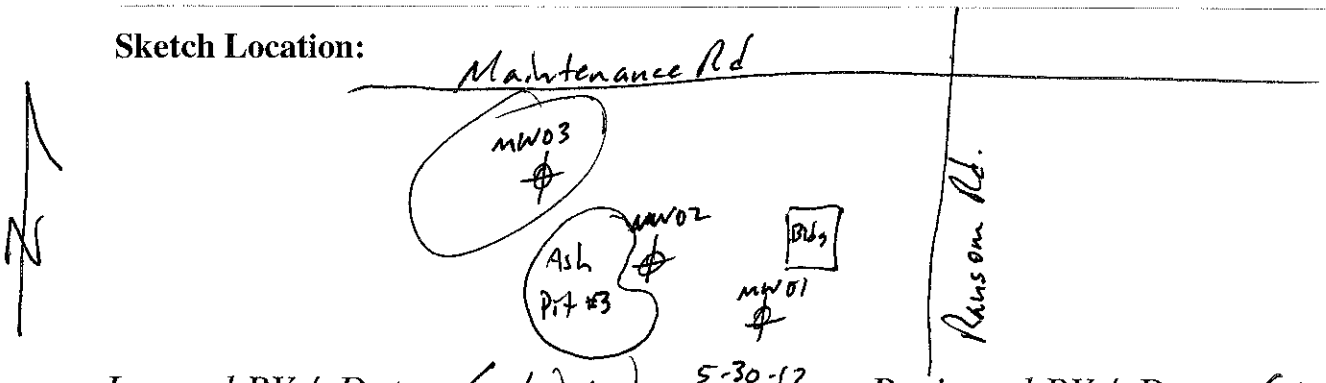
Analytical Suite	Flt	Frtn	Qty	Size	Units	Type	
EXPLOSIVES	N	A	~~2~~ 1	1	L	Amb. Glass	EW
~~SEMIVOLATILES3~~	~~N~~	~~B~~	~~2~~	~~1~~	~~L~~	~~Amb. Glass~~	EW
~~METALS3-W-F~~	~~Y~~	~~C~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW
~~HARDNESS~~	~~N~~	~~D~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW
METALS3-W	N	D	1	500	mL	HDPE	
~~ALKALINITY~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~CHLORIDE~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~SULFATE~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~TDS~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~TSS~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
~~TURB 180.1~~	~~N~~	~~E~~	~~1~~	~~1~~	~~L~~	~~HDPE~~	EW
VOLATILES	N	F	3	40	mL	VOA VIAL	
~~CYANIDE~~	~~N~~	~~G~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW
~~NO2/NO3~~	~~N~~	~~H~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~	EW

ERPIMS Values:
Sacode:
Lot Control#:

Groundwater Information:
Measured Well Depth: — **Depth To Water:** 7.88

Comments:

Sketch Location:



Logged BY / Date: E. W. Weaver 5-30-12 *Reviewed BY / Date:* Edward W. Weaver 6/12/12

APPENDIX B

SOIL BORING AND MONITORING WELL HTRW DRILL LOGS AND WELL CONSTRUCTION DIAGRAMS

HTRW DRILLING LOG

1. COMPANY NAME	Shaw E+I
2. DRILL SUBCONTRACTOR	NA
DISTRICT	Nashville CY3
HOLE NUMBER	SB01
SHEET / SHEETS	1 OF 2
3. PROJECT	PBOW
4. LOCATION	Sandusky, Ohio
5. NAME OF DRILLER	NA
6. MANUFACTURER'S DESIGNATION OF DRILL	NA
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	2" Stainless Steel Bucket Auger 3" Stainless Steel Bucket Auger
8. HOLE LOCATION	Coal Yard #3
9. SURFACE ELEVATION	639.33 N - 622941.18 E - 1914858.88
10. DATE STARTED	12/19/11 ~~12-20-11~~ JR
11. DATE COMPLETED	12/19/11 ~~12-20-11~~ JR
12. OVERBURDEN THICKNESS	>10'
13. DEPTH DRILLED INTO ROCK	0
14. TOTAL DEPTH OF HOLE	10'
15. DEPTH GROUNDWATER ENCOUNTERED	4.5'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	—
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	—

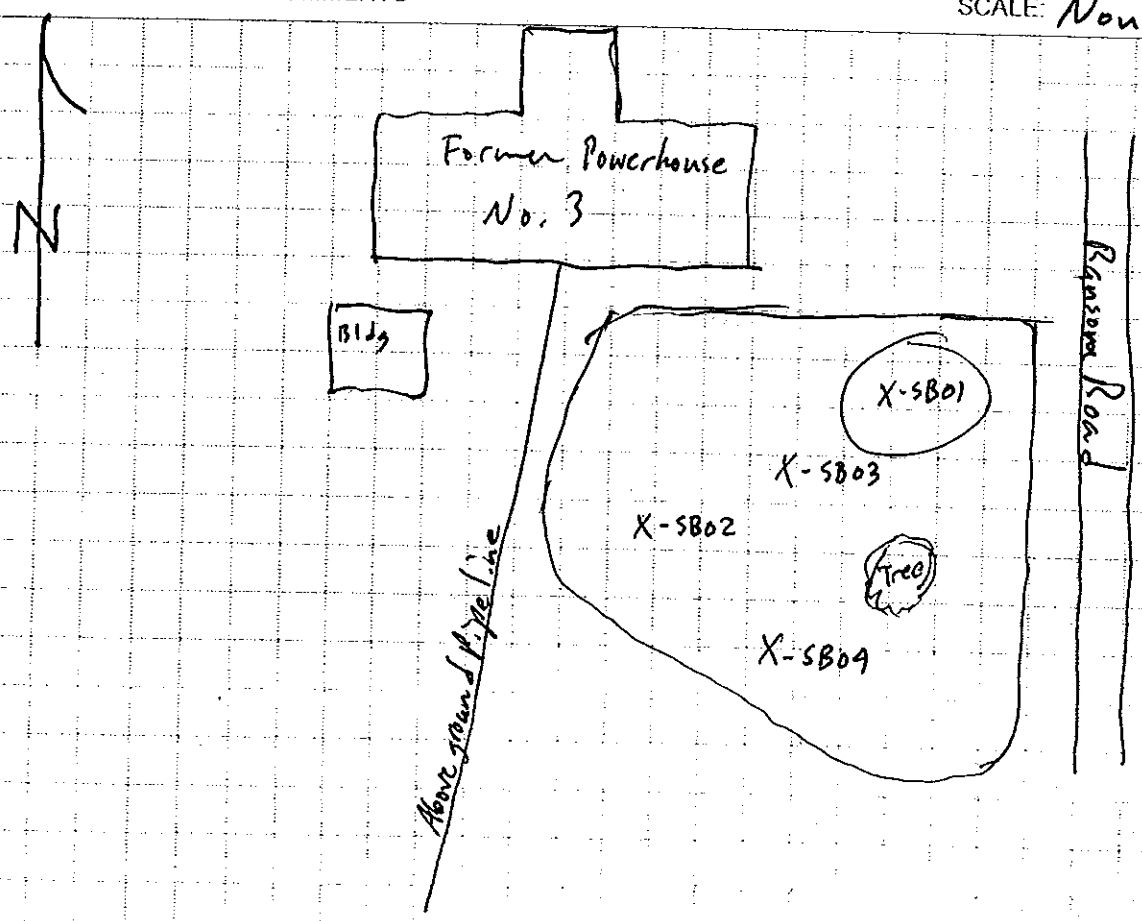
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19 TOTAL NUMBER OF CORE BOXES
—	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
✓	—	✓	Explosives	SVOC's	PCB's	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	✓	—	—	E. W. Weaver

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT PBOW

HOLE NO. CY3-SB01

DRC

Shaw
Shaw E&I, Inc.

HTRW DRILLING LOG (continuation sheet)

Hole Number: CY3-SB01

Project: PBOW

Geologist: E. Weaver

Sheet 2 of 2 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS	Field Screening Results (ppm)	~~Geotech. Sample or Core Box No.~~	Analytical Sample No.	Recovery (ft)	Remarks
		Very dark brown (10YR2/2) silt with clay, coal, moist, soft 0.2'	ML		Time	1		
		Dark yellowish brown (10YR4/6) silt with sand, gravel, clay, moist, medium stiff. 1.2'			1105	0.2'-1.2' CY0031		
	1							
		Brown (10YR4/3) silt with clay, sand, moist, medium stiff.						
	2							
	3					3.0'-5.0' CY0032 CY0033 CY0034		
	4				1119			
		-wet						
	5							
	6							
	7	7' Dark grayish brown (10YR4/2) silt, wet, medium stiff.						
	8					8.0'-10.0' CY0035		
	9				1140			
	10	Total Depth = 10 ft						

Project: PBOW

Hole Number: CY3-SB01

DEK

HTRW DRILLING LOG

DISTRICT	Nashville
HOLE NUMBER	CY3-SB02
SHEET / SHEETS	1 OF 2
1. COMPANY NAME	Shaw E+I
2. DRILL SUBCONTRACTOR	NA
3. PROJECT	PBOW
4. LOCATION	Sandusky, Ohio
5. NAME OF DRILLER	NA
6. MANUFACTURER'S DESIGNATION OF DRILL	NA
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	2" Stainless Steel Bucket Auger; 3" Stainless Steel Bucket Auger
8. HOLE LOCATION	Coal Yard #3
9. SURFACE ELEVATION	639.11 N-622897.02 E-1914797.95
10. DATE STARTED	12/19/11 ~~12-20-11~~ JR
11. DATE COMPLETED	12/19/11 ~~12-20-11~~ JR
12. OVERBURDEN THICKNESS	>10'
13. DEPTH DRILLED INTO ROCK	0
14. TOTAL DEPTH OF HOLE	10'
15. DEPTH GROUNDWATER ENCOUNTERED	2.5'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	—
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	—

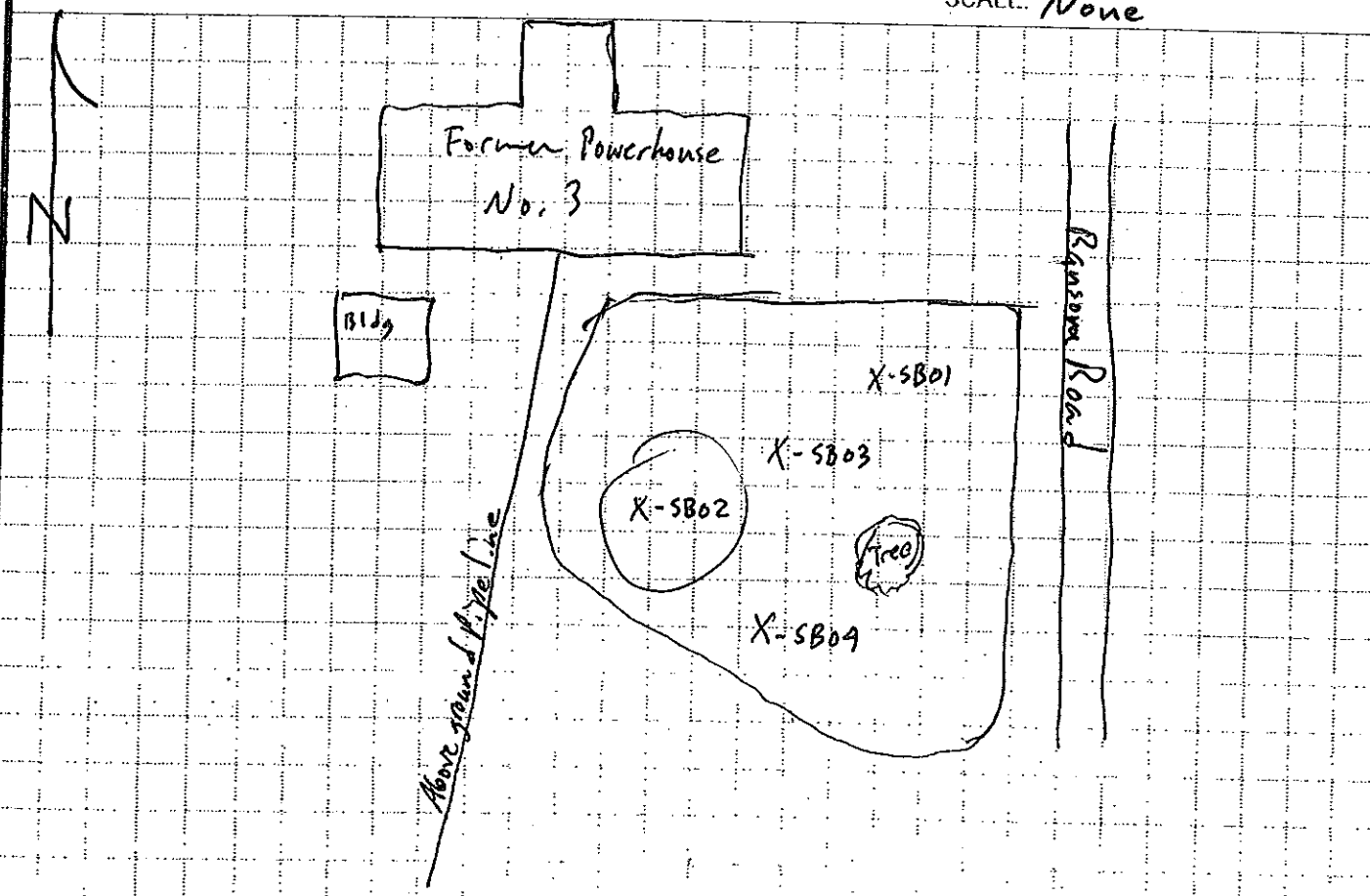
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
—	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
✓	—	✓	Explosives	SVOC's	PCB's	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	✓	—	—	E. W. Weaver

LOCATION SKETCH/COMMENTS

SCALE: None



CY3-SB02

PROJECT PBOW

HOLE NO. ~~CY-SB02~~ DRK

DRK

Shaw
Shaw E&I, Inc.

HTRW DRILLING LOG (continuation sheet)

Hole Number: CY-SB02

Project: PBOW | Geologist: E. Weaver | Sheet 2 of 2 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Very dark gray (10YR 3/1) silt with coal, sand, moist, loose. 0.3'	ML					
	1	Brown (10YR 4/3) silt with sand ballast rock, moist, ~~stiff~~. 1.5'						
	2	Brown (10YR 4/3) fine grain sand, with silt, moist, loose.	SM			1.5'-2.5' CY0036		
		– wet 3'						
	3	Very dark gray (10YR 3/1) silt with sand, wet, soft. 3.5'	ML			3.0'-5.0' CY0037		
	4	Light olive brown (2.5Y 5/3) silt with sand, wet, soft.						
	5							
	6							
	7							
	8					8.0'-10.0' CY0038		
	9							
	10	Total Depth = 10 Ft						

Project: PBOW | Hole Number: CY-SB02

DFK

HTRW DRILLING LOG

DISTRICT	Nashville
HOLE NUMBER	CY3-SB03
SHEET / SHEETS	1 OF 2
1. COMPANY NAME	Shaw E+I
2. DRILL SUBCONTRACTOR	NA
3. PROJECT	PBOW
4. LOCATION	Sandusky, Ohio
5. NAME OF DRILLER	NA
6. MANUFACTURER'S DESIGNATION OF DRILL	NA
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	2" Stainless Steel Bucket Auger 3" Stainless Steel Bucket Auger
8. HOLE LOCATION	Coal Yard #3
9. SURFACE ELEVATION	639.18 N-622921.16 E-1914832.59
10. DATE STARTED	~~12-20-11~~ 12/19/11 JR
11. DATE COMPLETED	~~12-20-11~~ 12/19/11 JR
12. OVERBURDEN THICKNESS	>10'
13. DEPTH DRILLED INTO ROCK	0'
14. TOTAL DEPTH OF HOLE	10'
15. DEPTH GROUNDWATER ENCOUNTERED	~~2.5~~
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	—
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	—

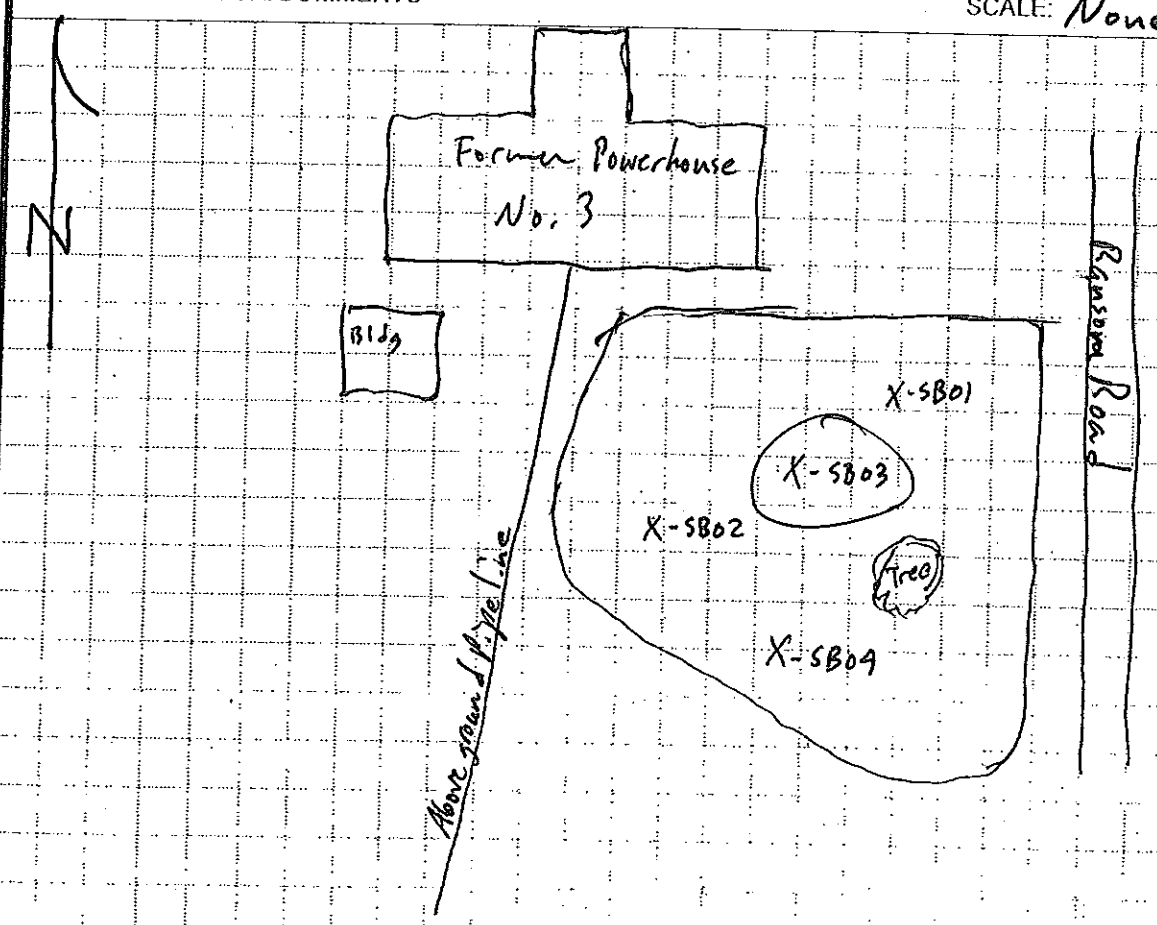
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
—	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
✓	—	✓	Explosives	SVOC's	PCB's	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	✓	—	—	E. W. Weaver

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT PBOW

HOLE NO. CY3-SB03

DPK

Shaw
Shaw E&I, Inc.

HTRW DRILLING LOG (continuation sheet)

Hole Number: CY3-SB03

Project: PBOW | Geologist: E. Weaver | Sheet 2 of 2 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS	Field Screening Results (ppm)	~~Geotech. Sample or Core Box No.~~	Analytical Sample No.	Recovery (ft)	Remarks
		Brown (10YR 4/3) silt with sand, clay, moist, medium stiff	ML		Time	0.0-1.0' CY0039		
					1540			
	1							
	2	2.5'						
		Very dark brown (10YR 2/2) silt with sand, clay, ~~moist~~ wet, medium stiff.						
	3					3.0-5.0' CY0040 CY0040MS CY0040MSD		
					1545			
	4							
	5							
	6							
	7	7'						
		Brown (10YR 4/3) silt with clay, wet, medium stiff.						
	8					8.0'-10.0' CY0041		
					1555			
	9							
	10	Total Depth = 10 Ft						

Project: PBOW | Hole Number: CY3-SB03

DKK

HTRW DRILLING LOG

1. COMPANY NAME	Shaw E+I
2. DRILL SUBCONTRACTOR	NA
DISTRICT	Nashville
HOLE NUMBER	CY3-SB04
SHEET / SHEETS	1 OF 2
3. PROJECT	PBOW
4. LOCATION	Sandusky, Ohio
5. NAME OF DRILLER	NA
6. MANUFACTURER'S DESIGNATION OF DRILL	NA
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	2" Stainless Steel Bucket Auger 3" Stainless Steel Bucket Auger
8. HOLE LOCATION	Coal Yard #3
9. SURFACE ELEVATION	639.16 N-622870.43 E-1914828.65
10. DATE STARTED	12/19/11 ~~12-20-11~~ JR
11. DATE COMPLETED	12/19/11 ~~12-20-11~~ JR
12. OVERBURDEN THICKNESS	>10'
13. DEPTH DRILLED INTO ROCK	0'
14. TOTAL DEPTH OF HOLE	10'
15. DEPTH GROUNDWATER ENCOUNTERED	3'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	—
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	—

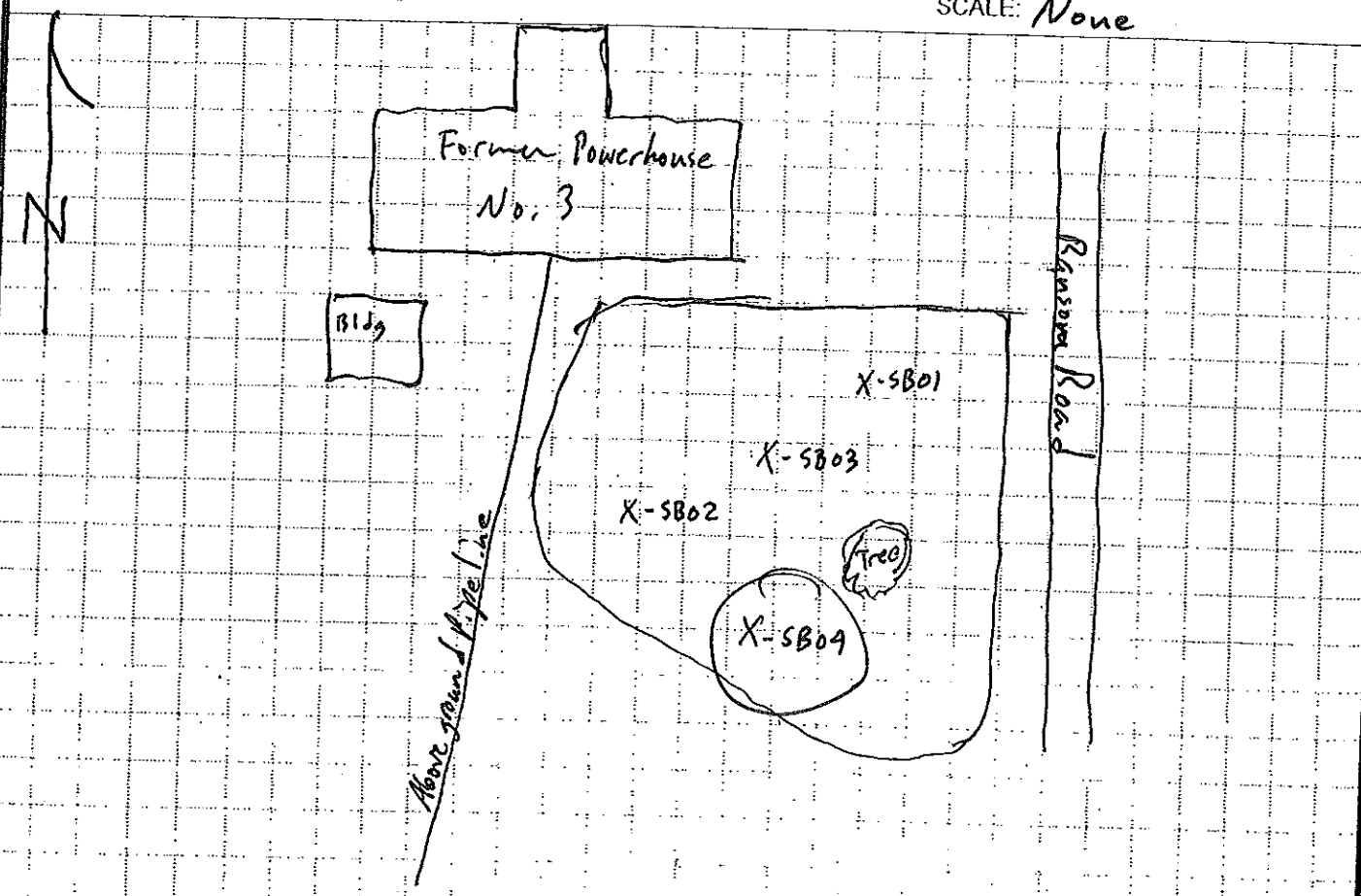
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
—	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
✓	—	✓	Explosives	SVOC's	PCB's	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	✓	—	—	Eric W. Weave

LOCATION SKETCH/COMMENTS

SCALE: None



PROJECT PBOW

HOLE NO. CY3-SB04

BKK

Shaw
Shaw E&I, Inc.

HTRW DRILLING LOG (continuation sheet)

Hole Number: CY3-SB04

Project: PBOW

Geologist: E. Weaver

Sheet 2 of 2 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS	Field Screening Results (ppm)	Geotech. ~~Sample or Core Box No.~~	Analytical Sample No.	Recovery (ft)	Remarks
		Dark grayish brown (10YR 4/2) silt with clay, moist, medium stiff.	ML		Time	0.0-1.0' CY0042		
	1							
	2							
		2.5'						
		Dark yellowish brown (10YR 4/6) silt with clay, moist, medium stiff. Wet at 3'.						
	3					3.0'-5.0' CY0043		
	4							
	5							
	6							
	7							
	8					8.0'-10.0' CY0044		
		9'						
	9	Grayish brown (10YR 5/2) clay with silt, moist, medium stiff.	CL					
	10	Total Depth = 10 Ft						

Project: PBOW

Hole Number: CY3-SB04

DICK

HTRW DRILLING LOG

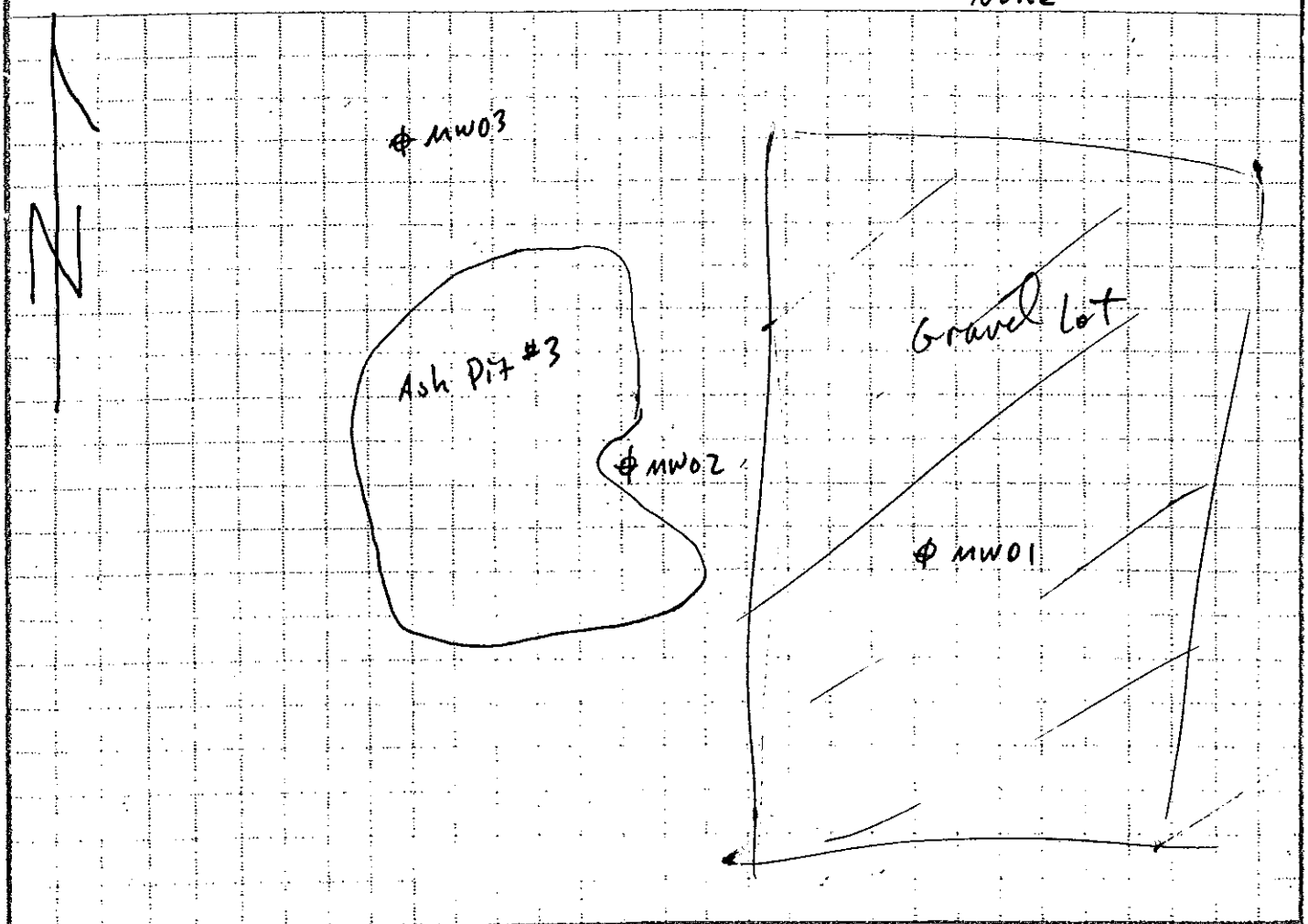
DISTRICT: Nashville	HOLE NUMBER: AP3-MW01	SHEET 1 OF 4 SHEETS
1. COMPANY NAME: Shaw E+I	2. DRILL SUBCONTRACTOR: MW Drilling	
3. PROJECT: PBOW	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: David Duncan	6. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe 7730 DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Geoprobe 2.25" OD Sample tube with liner - sampling 8.25" HSA tooling for well installation -	8. HOLE LOCATION: AP3-MW03~~BW~~1	
	9. SURFACE ELEVATION: 638.5' N-622910.53 E-1919684.10	
	10. DATE STARTED: 8-16-11	11. DATE COMPLETED: 8-17-11
12. OVERBURDEN THICKNESS: >29.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 7.5'	
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: —	
14. TOTAL DEPTH OF HOLE: 29.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): —	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY ___ %
None	—	—	—	—	—	

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	—	✓	—	Eric W. Weaver

LOCATION SKETCH/COMMENTS — SCALE: None



PROJECT: PBOW — HOLE NO.: AP3-MW01

Figure 4-2
Drilling Log

Shaw® Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number: AP3-MW01

Project: PBOW

Geologist: E. Weaver

Sheet 2 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Crushed limestone with silt, sand, gravel, dry, dense. 0.5	GM					Collected soil samples with DPT (2.25" OD) sample tube to refusal at 29'. Due to dryness of samples from 20'-29' well was installed at 29' bgs. Well was installed thru 4.25" ID HSA's. 10'-screen 10'-riser 0.2-bottom cap sand up to 2.5' bentonite up to 6' Flushmount installed at surface.
	1	Very dark brown (10YR 2/2) silt with clay, trace fine grain sand, moist, medium stiff	SM				2.2/5.0	
	2	2.1						
		Dark grayish brown (10YR 4/2) silt with clay, moist, medium stiff.						
	3							
	4							
	5	5.4'						
		Brown (10YR 5/3) silt with fine grain sand, trace clay, ~~wet~~ new moist, medium dense.						
	6						4.0/5.0	
	7	-wet						
	8							
	9							
	10							

Project: PBOW

Hole Number: AP3-MW01

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Figure 4-2
Drilling Log

Shaw® Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number: AP3 MW01

Project: PBOW

Geologist: E. Weaver

Sheet 3 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Crushed limestone with sand & gravel fill, dry, dense						
			SM					
	11							
							5.0 / 5.0	
	12							
	13							
	14							
	15							
		10.8'					2.5 / 2.5	
	16	Dark grayish brown (10YR 4/2) silt with clay, wet, medium stiff.	SM					
	17	17.1'						
		Dark gray (10YR 4/1) clay, wet, ~~medium~~ soft,	CL					
	18							
		18.7'					2.5 / 2.5	
	19	Dark gray (10YR 4/1) Clay with Shale fragments and gravel, moist, stiff.						
	20							

Project: PBOW

Hole Number: AP3-MW01

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Figure 4-2
Drilling Log

Shaw® Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number: AP3-MW01.

Project: PBOW

Geologist: E. Weaver

Sheet 4 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Dark gray (10YR4/1) clay with shale fragments, gravel, moist, stiff	CL					
	21	- grading to dry and very stiff.					2.5/2.5	
	22							
	23						2.5/2.5	
	24							
	25							
	26						2.5/2.5	
	27							
	28						1.5/1.5	
	29	Refusal @ 29 ft Total Depth = 29 ft DMK						
	30							

Project PBOW

Hole Number: AP3-MW01

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Figure 4-3
Monitoring Well Construction Form

Monitoring Well Construction Form

Project:	PBOW	Well Number:	AP3-MW01
Location:	Sandusky, Ohio	Site Location:	Ash Pit #3
Client:	USACE	Installation Date	8-16-11
Subcontractor:	MW Drilling	Northing:	622910.53
Driller:	Dave Duncan	Easting:	1914684.10
Shaw Field Representative:	E-Weaver	NAD:	NGVD:

* - Note that this well has a flushmount and not a stickup protective casing.

Protective Cover Elevation (ft):

Top of Casing Elv. (ft): 638.03

Top of Casing Stickup (ft): ~~EW~~

Land Surface Elv. (ft): 638.5

Approximate Diameter of Borehole (in): 8 1/2"

Well Casing Diameter (in): 2"

Depth to Water (ft):
- During Drilling: 7.5'
- Date: 8-16-11
- Post Development: TOC
- Date:

Top of Bentonite Seal (ft): 6.0'

Top of Filter Pack (ft): 7.5'

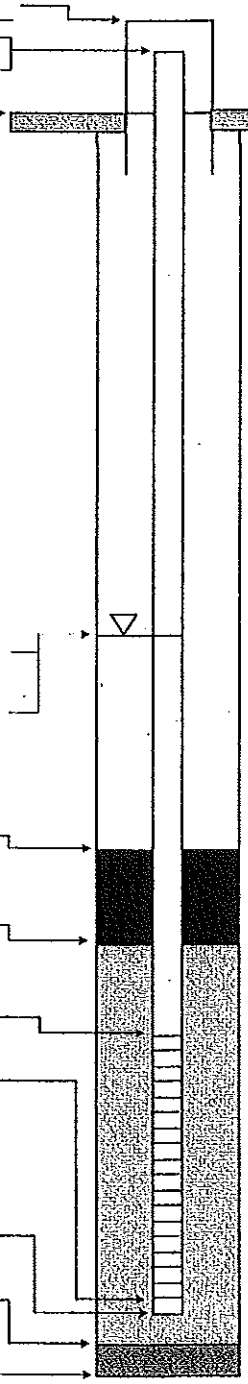
Top of Screen Interval (ft): 10.8'

Bottom of Screen Interval (ft): 20.8'

Bottom of Well (ft): 21.0'

Bottom of Filter Pack (ft): 21.5'

Bottom of Borehole (ft): ~~21.5'~~ DKK 29 ft



Protective Casing:
- Type: ~~Steel~~ Flushmount
- Dimensions (in): ~~4"~~ 8" EW
- Length (ft): ~~5'~~ 1'
- Guard Post: ~~4x~~ None

Ground Seal (Surface Pad)
- Dimensions: 2' x 2' x 6" ~~4' x 4' x 6"~~ EW
- Type: Concrete

Annular Space Seal:
- Type: Bentonite-Cement Grout
- Installation: (Gravity) Tremie Pumped

Bentonite Seal:
- Manufacturer: Halliburton
- Type: (Pellets) Slurry
- Installation: 6-in lifts (One Section) (Gravity) Tremie Pumped
- Hydration time (hrs): > 1 hr.

Filter Pack Material:
- Manufacturer: Southern Products + Silica Co.
- Product Name: Filter Media
- Size: #5
- Volume Added (ft³): 9 x 50 lbs bags
- Installation: (Gravity) Tremie

Well Casing:
- Manufacturer: Johnson
- Type: PVC
- Diameter (in): 2"

Well Screen Casing:
- Manufacturer: Johnson
- Type: PVC
- Slot Size (in): 0.010 %Open
- Slot Type: Continuous wrap (Factory slot)
- Sump/End Cap: 0.2

Backfill Material: Sand

Shaw® Shaw Environmental, Inc.

HTRW DRILLING LOG

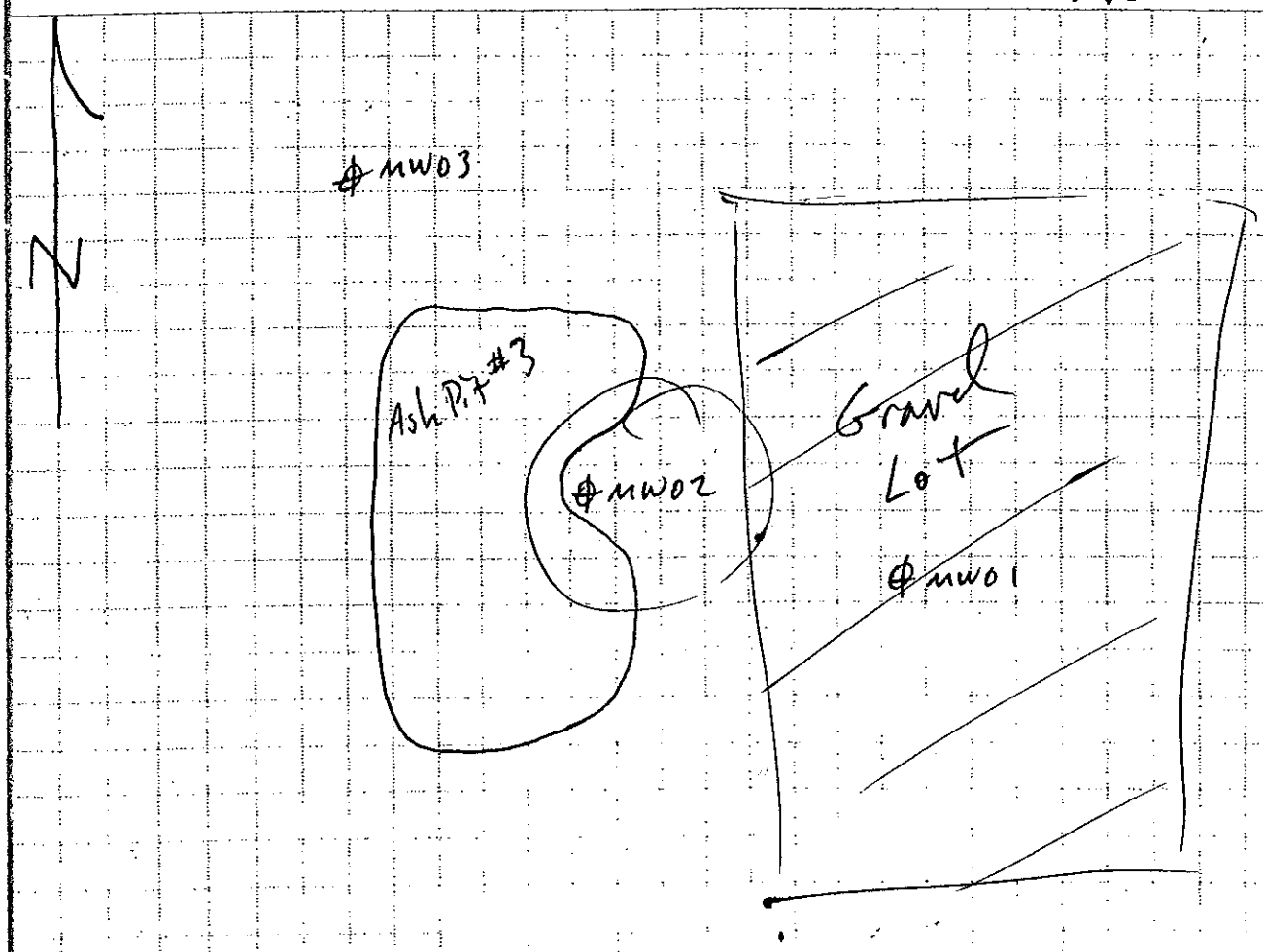
DISTRICT: Nashville	HOLE NUMBER: AP3-MW02	
1. COMPANY NAME: Shaw E+I	2. DRILL SUBCONTRACTOR: MW Drilling	SHEET 1 OF 4 SHEETS
3. PROJECT: PBOW	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: David Duncan	6. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe 7730 DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Geoprobe 2.25" OD Sample tube with 1 Mus. 8.5" OD HSA's to set well.	8. HOLE LOCATION: Ash Pit 3	
	9. SURFACE ELEVATION: 637.3' N- 622958.84 E- 1914572.39	
	10. DATE STARTED: 8-16-11	11. DATE COMPLETED: 8-17-11
12. OVERBURDEN THICKNESS: >28.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 6.2'	
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: —	
14. TOTAL DEPTH OF HOLE: 28.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): —	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
None	—	—	—	—	—	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	—	✓	—	Eric W. Weaver

LOCATION SKETCH/COMMENTS — SCALE: None



PROJECT: PBOW — HOLE NO. AP3-MW02

Figure 4-2
Drilling Log

Shaw® Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number: AP3-MW02.

Project: PBOW

Geologist: E. Weaver

Sheet 2 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Dark brown (10yr 3/3) silt with sand, gravel, clay, cinders, brick, concrete fragments, moist, medium stiff.	~~SM~~ FM					Completed soil sampling with DPT 2.25" OD sample tube with thru. TD-28' Completed Auger boring with 8.5" OD HSA's. Augered to 23' bgs Setwell at 22' bgs 0.2 bottom cap 10' screen 14.5' riser Added 11-50lbs bags sand. Added 1-5gallon buckets pellets
	1							
	2						2.6/5.0	
	3							
	4							
	5	~layered black ash from 5' to 6.2'.						
	6	6.2'						
		Dark grayish brown (10yr 4/2) silt with fine grain sandy clay, wet, soft.	SM					
	7						4.6/5.0	
	8							
	9							
	10							

Project: PBOW

Hole Number: AP3-MW02

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Figure 4-2
Drilling Log

Shaw® Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number: AP3-MW02

Project: PBOW

Geologist: E. Weaver

Sheet 3 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Dark grayish brown (10YR 4/2) silt with fine grain sandy clay, wet, soft.	SM EW					
	1							
	2						5.0/5.0	
	3							
	4	14.5'						
		Dark gray (10YR 4/1) Clay with silt, wet, soft.	CL					
	5							
	6						2.5/2.5	
	7							
	8						2.5/2.5	
		- grading to medium stiff with shale fragments						
	9							
	20							

Project PBOW

Hole Number AP3-MW02

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Figure 4-2
Drilling Log

Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number: AP3-MW02.

Project: PBOW

Geologist: E. Weaver

Sheet 4 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Dark gray (10YR4/1) clay with silt, shale fragments, moist, medium stiff.	CL					
	21							
	22						5.0 / 5.0	
	23	– grading to dry and very stiff						
	24							
	25							
	26						3.0 / 3.0	
	27							
	28	Refusal @ 28 ft. Total Depth = 28 ft. PEK						
	29							
	30							

Project PBOW

Hole Number: AP3-MW02

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Figure 4-3
Monitoring Well Construction Form

Monitoring Well Construction Form

Project:	PBOW	Well Number:	AP3-MW02
Location:	Sandusky, Ohio	Site Location:	Ash Pit #3
Client:	USACE	Installation Date	8-16-11
Subcontractor:	MW Drilling	Northing:	622958.84
Driller:	Dave Duncan	Easting:	1914572.39
Shaw Field Representative:	E. Weaver	NAD:	NGVD:

Protective Cover Elevation (ft): —
Top of Casing Elv. (ft): 640.24
Top of Casing Stickup (ft): 2.94
Land Surface Elv. (ft): 637.3'

Approximate Diameter of Borehole (in): 8.5"

Well Casing Diameter (in): 2"

Depth to Water (ft):
During Drilling: 6.2'
Date: 8-16-11
Post Development: TOC
Date:

Top of Bentonite Seal (ft): 6.0'

Top of Filter Pack (ft): 8.0'

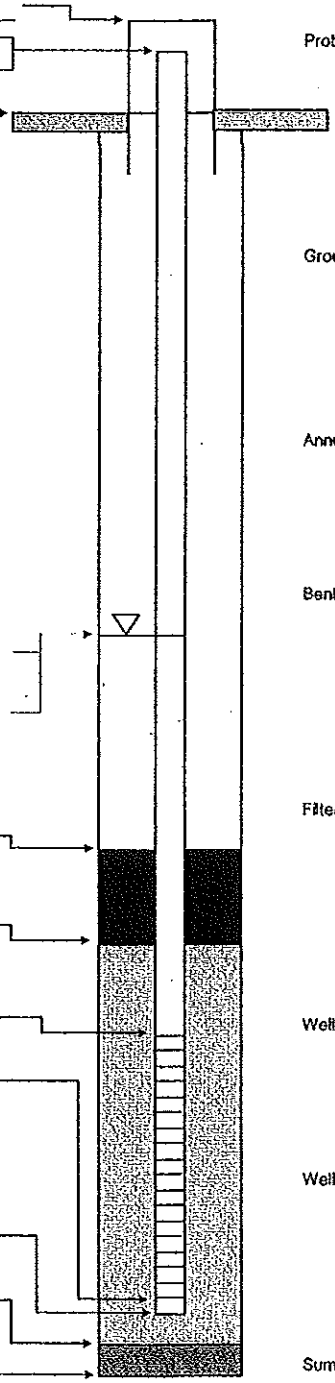
Top of Screen Interval (ft): 12.0'

Bottom of Screen Interval (ft): 22.0

Bottom of Well (ft): 22.2'

Bottom of Filter Pack (ft): 23.0'

Bottom of Borehole (ft): ~~23.0'~~ DKK 28.0



Protective Casing:
Type: Steel
Dimensions (in): 4"
Length (ft): 5'
Guard Post: 4"x 5'

Ground Seal (Surface Pad)
Dimensions: 4'x4'x 6"
Type: Concrete

Annular Space Seal:
Type: Bentonite-Cement Grout
Installation: (Gravity) Tremie Pumped

Bentonite Seal:
Manufacturer: Halliburton
Type: (Pellets) Slurry
Installation: 6-in lifts (One Section)
(Gravity) Tremie Pumped
Hydration time (hrs): >1 hr.

Filter Pack Material:
Manufacturer: Southern Products + Silica Co.
Product Name: Filter Media
Size: #5
Volume Added (ft³): 11 x 50 lbs bags
Installation: (Gravity) Tremie

Well Casing:
Manufacturer: Johnson
Type: PVC
Diameter (in): 2"

Well Screen Casing:
Manufacturer: Johnson
Type: PVC
Slot Size (in): 0.010 %Open
Slot Type: Continuous wrap Factory slot

Sump/End Cap: 0.2'

Backfill Material: Sand

Shaw® Shaw Environmental, Inc.

HTRW DRILLING LOG

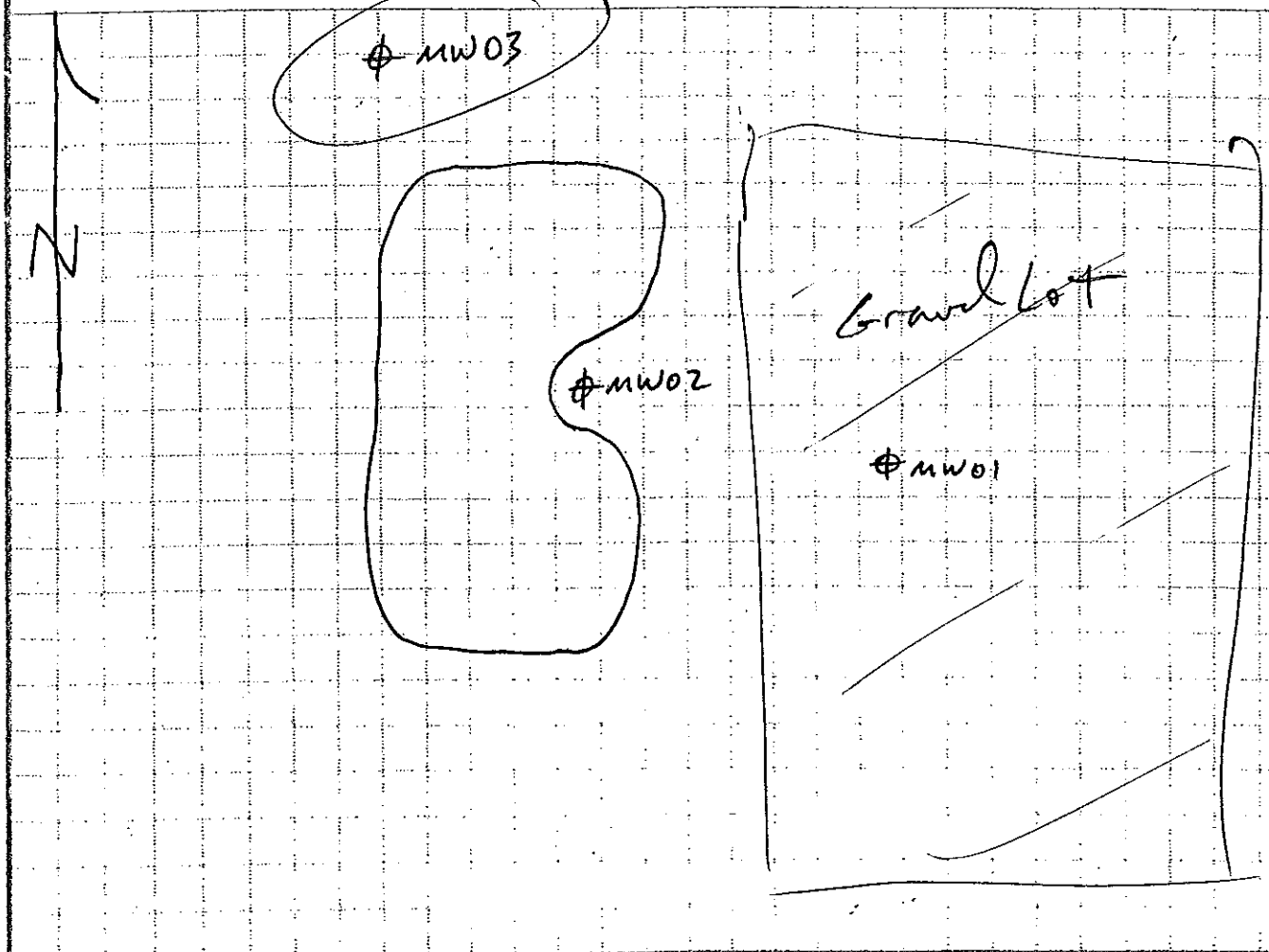
1. COMPANY NAME: Shaw E+I	DISTRICT: Nashville	HOLE NUMBER: AP3-MW03
2. DRILL SUBCONTRACTOR: MW Drilling		SHEET 1 OF 4 SHEETS
3. PROJECT: PBOW	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Dave Duncan	6. MANUFACTURER'S DESIGNATION OF DRILL: Geoprobe 7730 DT	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Geoprobe 2.25" OD Sample tube with liner - sampling; 8.25" OD HSA Tooling - Well Installation.	8. HOLE LOCATION: Ash Pit 3	
	9. SURFACE ELEVATION: 636.2' N-623077.56 E-1914421.69	
	10. DATE STARTED: 8-17-11	11. DATE COMPLETED: 8-18-11
12. OVERBURDEN THICKNESS: >27.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 6.2'	
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: —	
14. TOTAL DEPTH OF HOLE: 27.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): —	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
NA	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
NA	—	—	—	—	—	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	—	✓	—	E. W. Weaver

LOCATION SKETCH/COMMENTS — SCALE: None



PROJECT: PBOW — HOLE NO.: AP3-MW03

Figure 4-2
Drilling Log

Shaw® Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number AP3-MW03.

Project: PBOW

Geologist: E. Weaver

Sheet 2 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	1	Very dark gray (10YR 3/1) Silt with clay, organics, moist, medium stiff. 1.1'	SM					Completed soil sampling with DPT 2.25" OD sample tube with liners to refusal at 27'.
	2	Dark yellowish brown (10YR 4/4) silt with clay, moist, stiff.					4.1 / 5.0	Given dryness of material below 20' the MW will be installed at 20'-20.5' bgs.
	3							MW installed with 8.5" OD HSA's. Augered to 21' bgs.
	4							0.2 bottom cap 10' screen
	5							12.5' riser Sand up to 7' 11-6 bags sand
	6	6.2'					4.9 / 5.0	1-5 gallon bucket bentonite pellets. top pellet at 5' bgs
	7	Brown (10YR 4/3) silt with clay, fine grain sand, wet, soft						
	8	8.7'						
	9	Dark gray (10YR 4/1) silt, with clay, fine grain sand, wet, soft.						
	10	10'						

Project PBOW

Hole Number AP3-MW03

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Figure 4-2
Drilling Log

Shaw Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number AP3-MW03

Project: PBOW

Geologist: E. Weaver

Sheet 3 of 4 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Dark gray (10YR 4/1) clay with silt, wet, soft -	CL					
	1						4.5'/5.0'	
	2							
	3							
	4							
	5							
	6						4.4'/5.0'	
	7							
	8							
	9	19.3'						
	20	Dark gray (10YR 4/1) clay with silt, gravel, shale fragments, moist, medium stiff.						

Project PBOW

Hole Number AP3-MW03

Figure 4-2
Drilling Log

Shaw® Shaw Environmental, Inc.

DRILLING LOG

(continuation sheet)

Hole Number: AP3-MW03

Project: PBOW

Geologist: E. Weaver

Sheet 4 of Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Litho	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Dark gray (10YR 4/1) clay with silty gravel, shale fragments, moist, medium stiff.	CL					
	21							
							5.0 / 5.0	
	22	- gradiling to stiff						
	23							
	24							
	25	- gradiling to very stiff.						
							2.0 / 2.0	
	26							
	27	Refusal @ 27 FT Total Depth = 27 FT DFF						
	28							
	29							
	30							

Project: PBOW

Hole Number: AP3-MW03

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Figure 4-3
Monitoring Well Construction Form

Monitoring Well Construction Form

Project:	PBOW	Well Number:	AP3-MW03
Location:	Sandusky, Ohio	Site Location:	Ash Pit #3
Client:	USACE	Installation Date	8-17-11
Subcontractor:	MW Drilling	Northing:	623077.56
Driller:	Dave Duncan	Easting:	1914421.69
Shaw Field Representative:	E. Weaver	NAD:	NGVD:

Protective Cover Elevation (ft): —
Top of Casing Elv. (ft): 639.28'
Top of Casing Stickup (ft): 3.08'
Land Surface Elv. (ft): 636.2'

Approximate Diameter of Borehole (in): 8.25"

Well Casing Diameter (in): 2"

Depth to Water (ft):
During Drilling: 6.2'
Date: 8-17-11
Post Development: TOC
Date:

Top of Bentonite Seal (ft): 5.0'

Top of Filter Pack (ft): 7.0'

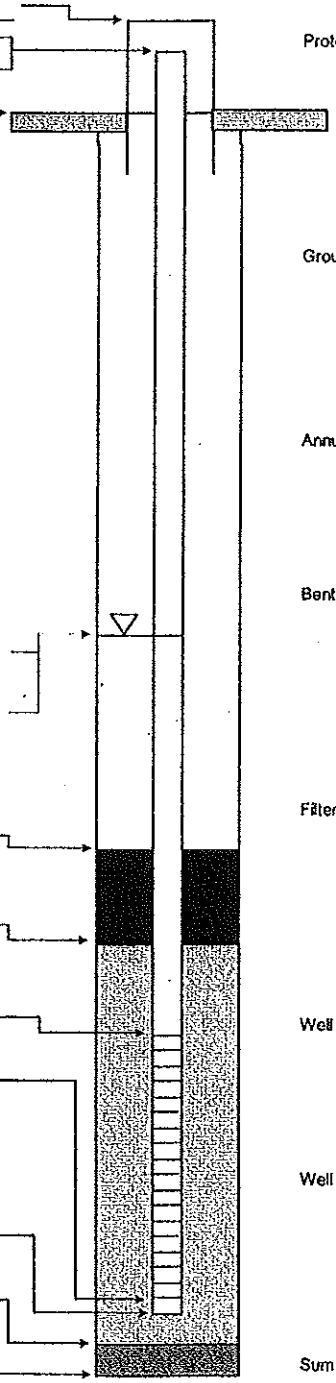
Top of Screen Interval (ft): 10.0'

Bottom of Screen Interval (ft): 20.0'

Bottom of Well (ft): 20.2

Bottom of Filter Pack (ft): 20.5

Bottom of Borehole (ft): ~~20.5~~ 27.0



Protective Casing:
Type: Steel
Dimensions (in): 4"
Length (ft): 5'
Guard Post: 4"x5'

Ground Seal (Surface Pad)
Dimensions: 4'x4'x6"
Type: Concrete

Annular Space Seal:
Type: Bentonite-Cement Grout
Installation: (Gravity) Tremie Pumped

Bentonite Seal:
Manufacturer: Halliburton
Type: (Pellets) Slurry
Installation: 6-in lifts (One Section)
(Gravity) Tremie Pumped
Hydration time (hrs): >1 hr.

Filter Pack Material:
Manufacturer: Southern Products + Silica Co.
Product Name: Filter media
Size: #5
Volume Added (ft^3): 11 x 50 lbs bags
Installation: (Gravity) Tremie

Well Casing:
Manufacturer: Johnson
Type: PVC
Diameter (in): 2"

Well Screen Casing:
Manufacturer: Johnson
Type: PVC
Slot Size (in): .010 %Open
Slot Type: Continuous wrap (Factory slot)

Sump/End Cap: 0.2

Backfill Material: Sand

Shaw® Shaw Environmental, Inc.

APPENDIX C

WELL DEVELOPMENT LOGS AND WATER PHOTOGRAPHS

Shaw
Shaw E & I, Inc.

Figure 4-6

Well Development Log

Project Number: 119268
Project Name: PBOW
Form Completed by: E. Weaver
Well Developed by/firm: Shaw E+I

Site ID: AP3
Location ID: AP3-MW01
Date Started: 11-16-11

Monitoring Well Information

Development Method: Surge + Purge
Development Equipment: Waterra Inertial Pump, Tubing, check valve, Surge block

Screen Height (ft): 10'
Filter pack length (ft): 12'
Casing Diameter (in): 2"

Begining Measurements (BTOC)
Depth to Water (ft): 2.20' btoc
Total depth of Well (ft): 20.29' btoc

Monitoring Well Purge Calculations

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where casing diameter in inches = (0.041 x (2)^2) = 0.164 gal/ft.
Well Volume (gallons) = Water Column (ft) x Gal/ft = 18.09 ft x 0.164 gal/ft = 2.97 gallons

Volume of Water in Filter Pack:
Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole diameter in inches & d is casing diameter in inches = 0.041 x ((8.25)^2 - (2)^2) = 2.63 gal/ft.
(8.25 = 6 3/8 + 0.06; 2 = 4)
Filter Pack Volume (gal) = (the less of the filter pack lenght or water column) x gal/ft x porosity (0.3) = (12)ft x (2.63) gal/ft x 0.3 = 9.47 gal

Purge Well Volume: Purge well Volume = Filter pack volume + Well Volume = 9.47 gal + 2.97 gal = 12.44 gal.

1 x Purge Well Volume	2 x Purge Well Volume	3 x Purge Well Volume	4 x Purge Well Volume	5 x Purge Well Volume
12.44	24.88	37.32	49.76	62.2

Development Record

	Time (24 hrs)	Volume Removed (gal)	Water Level (ft) (TOC)	Turbidity (NTU)	Clarity (color)	Temp. (C)	pH (Std Units)	Conductivity (mS/cm)	D.O. (mg/L)	Redox (mV)	Comments
11-16-11	1510	Start	2.20'	Begin pumping at 10' (top of screen) with surge block. Pump for 2 min then lower 1' and							
	1547	End 25 gal	5.80'	repeat process to bottom of well. Then return to top of screen and do same at 1 min intervals.							
12-1-11	1100	start	1.00	Begin pumping at top of screen. Pump at high rate for 2 mins then lower							
	1200	End 45 gal	3.4'	1 ft and repeat process to bottom of screen.							
	0928	Start	0.97'	—	—	—	—	—	—	—	Begin pumping
12-2-11	0940	1.2 gal	1.30'	85.4	slightly cloudy	12.69	8.15	0.907	5.55	-52.3	Pumping at 380 ml/min
	0955	2.9 gal	1.35'	20.8	clear	12.74	7.52	0.909	8.12	-26.6	Pumping at 430 ml/min
	1010	4.7 gal	1.40'	9.5	clear	12.89	7.47	0.923	7.87	-25.4	Pumping at 450 ml/min
	1025	6.5	1.40'	0.0	clear	12.56	7.51	0.904	9.29	-27.4	Pumping at 460 ml/min

continued on next page

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Shaw E & I, Inc.

Figure 4-6

Well Development Log (Continuation)

Site ID: AP3
Location ID: AP3-MW01
Date Started: 11-16-11

12-2-11

Development Record (continuation)

Time (24 hrs)	Volume Removed (gal)	Water Level (ft) (TOC)	Turbidity (NTU)	Clarity (color)	Temp. (C)	pH (Std Units)	Conductivity (mS/cm)	D.O. (mg/L)	Redox (mV)	Comments
1040	8.2	1.40'	0.0	clear	12.46	7.62	0.901	9.63	-32.0	Pump log at 420 ml/min
1055	10	1.40'	0.0	clear	12.50	7.57	0.886	6.92	-26.6	Pump log at 450 ml/min
—	—	—	—	—	—	—	—	—	—	Collect sample for photograph
					EW					

Water Added: type NA volume NA (gal.)
Chemical Added: type NA volume NA (gal.)
Range and Average Discharge Rate: 0.1 to 0.9 gallons per minute / 0.57 gpm Average
Maximum Drawdown during Development: 3.4' at 0.9 gpm.
Disposition of Development Water: (Drums) Baker Tank Other
Number of Containers for Development Water: 1.5-55 gallon drums

Comments:

Final Measurements (BTOC)

Total depth of Well (ft): 20.29'

Date Completed: 12-2-11

Hours Developed: 2 hr. 54 min.

Shaw
Shaw E & I, Inc.

Figure 4-6

Well Development Log

Project Number: 119268
Project Name: PBOW
Form Completed by: EW
Well Developed by/firm: Shaw E+I

Site ID: AP3
Location ID: AP3-MW02
Date Started: 11-10-11

Monitoring Well Information

Development Method: Surge+Purge
Development Equipment: Waterra Pump, check valve, surge block, tubing

Screen Height (ft): 10'
Filter pack length (ft): 12'
Casing Diameter (in): 2"

Begining Measurements (BTOC)
Depth to Water (ft): 6.72
Total depth of Well (ft): 24.85

Monitoring Well Purge Calculations

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where casing diameter in inches = (0.041 x (2)^2) = 0.164 gal/ft.
Well Volume (gallons) = Water Column (ft) x Gal/ft = 18.13 ft x 0.164 gal/ft = 2.97 gallons

Volume of Water in Filter Pack:
Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole diameter in inches & d is casing diameter in inches = 0.041 x ((8.25)^2 - (2)^2) = 2.63 gal/ft.
Filter Pack Volume (gal) = (the less of the filter pack lenght or water column) x gal/ft x porosity (0.3) = (12)ft x (2.63) gal/ft x 0.3 = 9.47 gal

Purge Well Volume: Purge well Volume = Filter pack volume + Well Volume = 9.47 gal + 2.97 gal = 12.44 gal.

1 x Purge Well Volume	2 x Purge Well Volume	3 x Purge Well Volume	4 x Purge Well Volume	5 x Purge Well Volume
12.44	24.88	37.32	49.76	62.2

Development Record

	Time (24 hrs)	Volume Removed (gal)	Water Level (ft) (TOC)	Turbidity (NTU)	Clarity (color)	Temp. (C)	pH (Std Units)	Conductivity (mS/cm)	D.O. (mg/L)	Redox (mV)	Comments
11-10-11	1458	Start	6.72	Begin pumping with surge block at top of screen. Pumped for 2 min, lower							
	1538	End 15 gal	Dry	Pump 1 foot then repeat process to bottom of well.							
11-15-11	1620	Start	6.64	Begin pumping with ~~surge block~~ GW check valve at top of screen. Pump for 1 min then lower							
	1642	End 14 gal	Dry	1 ft and repeat process to bottom of well.							
11-18-11	1047	Start	6.73	Begin pumping at top of screen. Pump for 1 min then lower 1' and repeat to bottom							
	1110	End 14 gal	Dry	of screen.							
11-30-11	1542	Start	6.77	—	—	—	—	—	—	—	~~Pumping at 200 ml/min~~
	1550	0.3 gallons	7.73	5.6	Clear	8.37	8.50	1.348	12.20	-59.2	Pumping at 150 ml/min
	1605	0.9 gallons	9.14	0.0	clear	8.65	8.32	1.330	11.84	-49.7	Pumping at 150 ml/min

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Shaw E & I, Inc.

Figure 4-6

Well Development Log (Continuation)

Site ID: AP3
Location ID: AP3-MW02
Date Started: 11-10-11

11-30-11

Development Record (continuation)

Time (24 hrs)	Volume Removed (gal)	Water Level (ft) (TOC)	Turbidity (NTU)	Clarity (color)	Temp. (C)	pH (Std Units)	Conductivity (mS/cm)	D.O. (mg/L)	Redox (mV)	Comments
1620	1.5 gallon	10.52	0.0	clear	9.32	8.24	1.314	11.52	-47.6	Pumping at 150 ml/min
1635	2.3 gallon	12.78	0.0	clear	9.16	8.28	1.273	11.80	-48.3	Pumping at 200 ml/min
1650	3.1 gallon	14.26	0.0	clear	9.27	8.25	1.258	11.50	-46.4	Pumping at 200 ml/min

Water Added: type — volume — (gal.)
Chemical Added: type — volume — (gal.)
Range and Average Discharge Rate: —
Maximum Drawdown during Development: Dry at gpm.
Disposition of Development Water: Drums Baker Tank Other
Number of Containers for Development Water: 1 drum

Comments:

Final Measurements (BTOC)

Total depth of Well (ft): 24.85'

Date Completed: 11-30-11

Hours Developed: 2 hr. 33 mins

Shaw
Shaw E & I, Inc.

Figure 4-6

Well Development Log

Project Number: 119268
Project Name: PBOW
Form Completed by: EW
Well Developed by/firm: Shaw E+I

Site ID: AP3
Location ID: AP3-MW03
Date Started: 11-10-11

Monitoring Well Information

Development Method: Surge + Purge
Development Equipment: Waterra Inertial Pump, Tubing, check valve, surge block

Screen Height (ft): 10'
Filter-pack length (ft): 12'
Casing Diameter (in): 2"

Begining Measurements (BTOC)
Depth to Water (ft): 10.43
Total depth of Well (ft): 23.39

Monitoring Well Purge Calculations

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where casing diameter in inches = (0.041 x (2)^2) = 0.164 gal/ft.
Well Volume (gallons) = Water Column (ft) x Gal/ft = 12.96 ft x 0.164 gal/ft = 2.13 gallons

Volume of Water in Filter Pack:
Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole diameter in inches & d is casing diameter in inches = 0.041 x ((8.25)^2 - (2)^2) = 2.63 gal/ft.
68.06 4
Filter Pack Volume (gal) = (the less of the filter pack lenght or water column) x gal/ft x porosity (0.3) = (12)ft x (2.63) gal/ft x 0.3 = 9.47 gal

Purge Well Volume: Purge well Volume = Filter pack volume + Well Volume = 9.47 gal + 2.13 gal = 11.6 gal.

1 x Purge Well Volume	2 x Purge Well Volume	3 x Purge Well Volume	4 x Purge Well Volume	5 x Purge Well Volume
11.6	23.2	34.8	46.4	58

Development Record

	Time (24 hrs)	Volume Removed (gal)	Water Level (ft) (TOC)	Turbidity (NTU)	Clarity (color)	Temp. (C)	pH (Std Units)	Conductivity (mS/cm)	D.O. (mg/L)	Redox (mV)	Comments
11-10-11	1401	Start	10.43	Purged on med. high speed with surge block starting at top of screen. Pumped							
	1435	End 12 gal	Dry	for 2 min then lowered 1 foot and repeat to bottom of screen							
11-18-11	1415	Start	8.87	Purged on high with surge block. Started at top of screen pumped for 2 min then							
	1442	End 13 gal	Dry	lowered 1' and repeat process to bottom of screen. Water clearing up.							
11-18-11	1018	Start	14.17	Begin pumping at top of screen. Pump for 1 min then lower 1' and repeat to bottom							
	1032	End 8 gal	Dry	of well. Water clear.							
12-1-11	0925	Start	4.74	—	—	—	—	—	—	—	Pumping at 360 ml/min
	0935	1 gallon	8.78	0.0	clear	9.88	8.14	2.087	10.05	-50.0	Pumping 360 ml/min
	0950	1.8 gallon	11.50	0.0	clear	8.88	7.85	1.894	11.15	-38.6	Pumping at 200 ml/min

continued on next page

Shaw
Shaw E & I, Inc.

Figure 4-6

Well Development Log (Continuation)

Site ID: AP3
Location ID: AP3-MW03
Date Started: 11-30-11

12-1-11

Development Record (continuation)

Time (24 hrs)	Volume Removed (gal)	Water Level (ft) (TOC)	Turbidity (NTU)	Clarity (color)	Temp. (C)	pH (Std Units)	Conductivity (mS/cm)	D.O. (mg/L)	Redox (mV)	Comments
1005	2.5 gal	13.60	0.0	clear	9.51	7.78	1.794	9.96	-37.4	Pumping at 280 ml/min
1020	3.6 gal	13.58	0.0	clear	9.80	7.93	1.745	10.90	-43.1	Pumping at 280 ml/min
1035	4.8	13.58	0.0	clear	10.02	7.94	1.748	10.75	-44.1	Pumping at 290 ml/min
1050	6.0	13.59	0.0	clear	9.78	8.01	1.713	10.60	-46.6	Pumping at 300 ml/min
—	—	—	—	—	—	—	—	—	—	Collect Sample for photographs

Water Added: type NA volume NA (gal.)
Chemical Added: type NA volume NA (gal.)
Range and Average Discharge Rate: —
Maximum Drawdown during Development: Dry at gpm.
Disposition of Development Water: Drums Baker Tank Other
Number of Containers for Development Water: 1 drum

Comments:

Final Measurements (BTOC)

Total depth of Well (ft): 23.39

Date Completed: 12-1-11

Hours Developed: 2 hrs. 40 min.

Shaw Environmental, Inc.
Photographic Record

Client: USACE	**Project Number: 119268**
Site Name: Former Plum Brook Works	**Site Location: Sandusky, Erie County, Ohio**

Well:

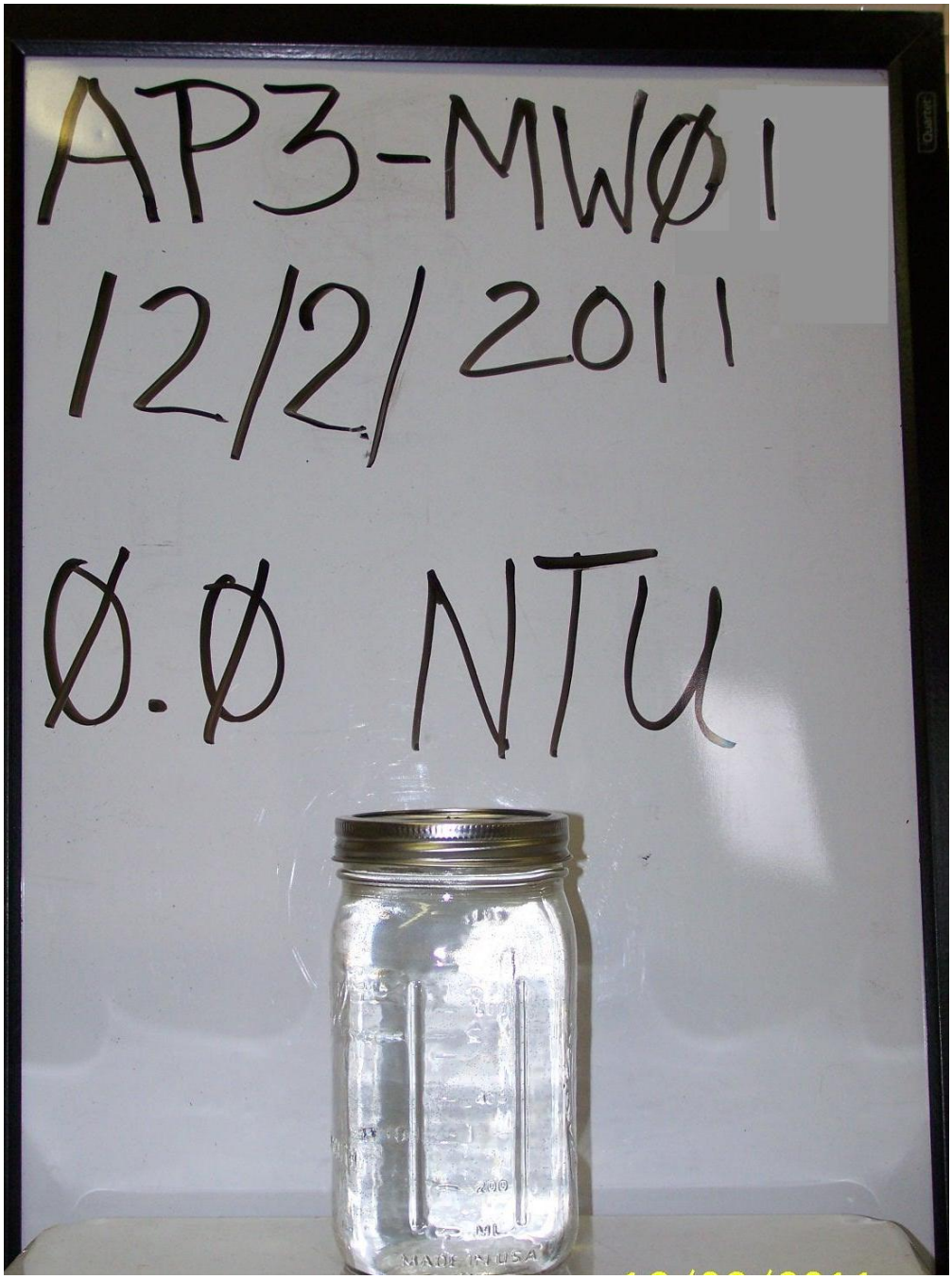
AP3-MW01

Date:

December 2, 2011

Final reading:

0.0 NTU



Shaw Environmental, Inc.
Photographic Record

Client: USACE	**Project Number: 119268**
Site Name: Former Plum Brook Works	**Site Location: Sandusky, Erie County, Ohio**

Well:

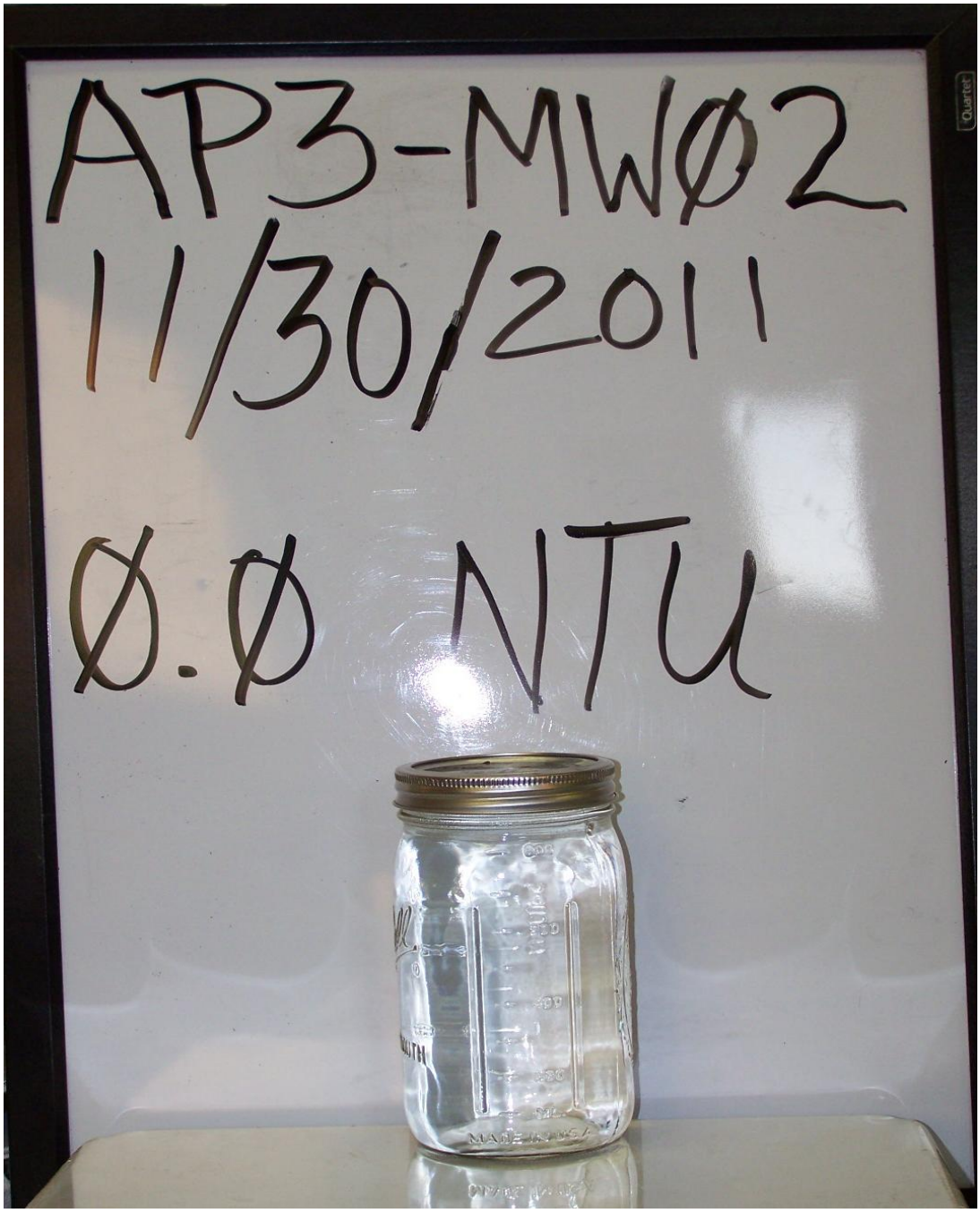
AP3-MW02

Date:

November 30, 2011

Final reading:

0.0 NTU



Shaw Environmental, Inc.
Photographic Record

Client: USACE	**Project Number: 119268**
Site Name: Former Plum Brook Works	**Site Location: Sandusky, Erie County, Ohio**

Well:

AP3-MW03

Date:

December 1, 2011

Final reading:

0.0 NTU

APPENDIX D

LAND SURVEY DATA

FINAL REPORT
of
SURVEYING SERVICES PERFORMED
by
SACKS SURVEYING & MAPPING, P.C. / KUSMER & ASSOCIATES J.V.
at the
PLUMBROOK ORDNANCE WORKS, SANDUSKY, OH
for
SHAW E & I
MAY - NOVEMBER, 2011

SUMMARY OF WORK PERFORMED

Between May, 2011 and November, 2011, Sacks Surveying & Mapping, PC, in joint venture with Kusmer & Associates, Inc., surveyed a total of 255 environmental sampling locations (soil samples, soil bores, test pits, sediment samples, piezometers, and monitoring wells) throughout the Plumbrook Ordnance Works facility. Surveying was performed over the course of three separate mobilizations, described more particularly as follows:

1st Mobilization (23-27 May, 2011) - 44 survey points: Unloading Area (12 points); Sellite Area (11 points); Wastewater Treatment Plant #2 site (10 points); and TNT C Sewer Line (11 points).
2ND Mobilization (26-30 September, 2011) – 176 survey points: Wastewater Treatment Plant #2 site (4 points); TNT C Sewer Line (3 points); Steel Sewer Line (40 points); Sellite Area (23 points); Unloading Area (3 points); TNT A Sewer Line (24 points); Ash Pit #3 (3 points); and Acid Area #1 (76 points).
3RD Mobilization (7-10 November, 2011) – 35 survey points: Acid Area #1 (12 points); Sellite Area (11 points); Coal Yard #1 (4 points); Coal yard 32 (4 points); and Coal Yard #3 (4 points)

Work was performed in accordance with Shaw E & I surveying specifications under purchase orders #680616-000 OP, 680686-000 OP, 680702-000 OP, and 680711-000 OP.

KEY PERSONNEL

W. Robert Kusmer – Ohio Land Surveyor S-6754
Stanley Robert Sacks – North Carolina Surveyor L-2913
Michael A. McKibbin – North Carolina Surveyor L-4519, Hazmat Project Manager
Jeff Bucholtz – On-site Party Chief *
Paul Lewis – Survey Technician *
* all on-site personnel for this project are OSHA 29 CFR 1910.120 40-hour trained and medically monitored in accordance with Shaw E & I requirements.

FIELD PROCEDURES

All sampling locations reported below were surveyed with a Topcon GTS-235 Total Station using conventional angle and distance measurements to determine the horizontal and vertical position thereof. Survey control used meets or exceeds the standards for a Third Order, Class II horizontal and Third Order vertical survey as defined in the Standards and Specifications for Geodetic Control Networks (1984). The survey control points used in this operation were established by this firm, presently or previously (January, 2009), by direct static differential GPS observation using three Ashtech Promark II GPS receivers with reference to NGS Monument

"Sky D" as a fixed horizontal reference and NGS Monument "J-318" (a first order benchmark) as a fixed vertical reference. The horizontal datum is NAD 83(1995). The vertical datum is NGVD 29. Values were scaled to the Ohio State Plane Coordinate System (North Zone) using a combined scale and ellipsoid factor of 0.999927034.

SKY D:	J-318:
Northing (y) 196,085.494 m	Northing (y) 196,170 m +/-
Easting (x) 586,761.658 m	Easting (x) 583,400 m +/-
Orthometric Elevation 175.30 m +/-	Orthometric Elevation 182.801 m
(SKYD not used as vertical control)	(First Order Class II NGVD 29 Benchmark)

CERTIFICATION

I, Warren Robert Kusmer, Ohio Professional Surveyor #S-6754, hereby certify that the information in this survey report is true to the best of my knowledge and belief.

W Robert Kusmer

Warren Robert Kusmer,
Ohio Professional Surveyor #S-6754

12/29/2011

Date

SAMPLE LOCATIONS:

Sellite Area (May 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
176	623869.42	1916750.44	637.70	636.3	PZ-01/SB-01
190	624014.07	1916719.34	635.50	633.5	PZ-02/SB-02
188	624020.14	1916786.02	635.51	632.9	PZ-03/SB-08
178	623929.48	1916752.25	639.51	636.6	PZ-04/SB-11
184	623934.02	1916892.19	634.43	633.7	PZ-05/SB-12
182	623872.51	1916884.23	634.37	633.8	PZ-06/SB-14
186	623895.85	1916986.31	634.44	632.9	PZ-07
193	623956.38	1916636.65	637.76	634.9	PZ-08
174	623798.08	1916683.07	636.59		SB-06
173	623786.75	1916777.79	636.27		SB-07
194	623888.92	1916843.75	636.95		SB-13

Sellite Area (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1351	623784.44	1916774.54	639.23	636.3	FSB MW-01
1339	623876.91	1916738.07	638.99	635.9	FSB MW-02
1335	624104.10	1916731.84	637.31	634.5	FSB MW-03
1341	624087.55	1916684.17	634.67		FSBSB-15
1347	623629.46	1917087.66	633.09		FSBSD-01
1346	623776.17	1917073.42	631.57		FSBSD-02
1365	623907.05	1917011.31	630.62		FSBSD-03
1364	624003.39	1916967.91	630.28		FSBSD-04
1362	624042.36	1916741.69	632.46		FSBSD-05
1363	623994.37	1916632.10	630.44		FSBSD-06
1357	623902.10	1916716.24	636.31		FSBSS-01
1359	623901.30	1916753.54	636.35		FSBSS-02
1358	623885.21	1916694.10	636.85		FSBSS-03
1360	623890.92	1916784.72	636.34		FSBSS-04
1356	623857.12	1916694.62	636.61		FSBSS-05
1361	623859.54	1916784.34	636.24		FSBSS-06
1355	623830.07	1916703.62	636.60		FSBSS-07
1354	623807.59	1916713.95	636.40		FSBSS-08
1353	623801.60	1916743.43	636.21		FSBSS-09
1352	623808.70	1916775.45	636.09		FSBSS-10
1445	623865.15	1916885.40	633.95		FSBTOC-01
1446	623932.91	1916885.13	633.99		FSBTOC-02
1447	624015.89	1916713.76	633.89		FSBTOC-03

Sellite Area (November 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1573	623883.26	1916668.05	637.11		SELSS-14
1575	623923.25	1916681.43	636.44		SELSS-15
1576	623943.21	1916722.42	636.04		SELSS-16
1577	623921.93	1916798.71	636.90		SELSS-17
1567	623853.57	1916821.88	636.27		SELSS-18
1568	623810.03	1916811.69	636.44		SELSS-19
1569	623759.95	1916739.76	636.59		SELSS-20
1566	623813.26	1916892.50	634.84		SELSS-21
1570	623813.21	1916632.33	637.07		SELSS-22
1571	623834.86	1916668.04	637.22		SELSS-23
1572	623890.63	1916627.56	636.31		SELSS-24

Unloading Area (May 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
165	623921.17	1917391.09	637.81	634.9	PZ-01/SB-01
163	623922.42	1917456.71	639.09	635.6	PZ-02/SB-04
151	623746.08	1917524.35	639.19	637.5	PZ-03/SB-11
154	623845.17	1917437.12	636.83	636.0	PZ-04/SB-02
161	623948.26	1917535.43	639.75	636.9	PZ-05
171	623948.78	1917093.30	634.92	633.9	PZ-06
169	623972.05	1917234.56	636.91	634.1	PZ-07
156	623752.04	1917199.54	633.98	633.3	PZ-08
166	623930.55	1917322.87	633.71		SB-06
167	623924.05	1917228.33	634.30		SB-07
170	623913.67	1917151.13	633.88		SB-09
152	623770.64	1917492.33	637.19		SB-12

Unloading Area (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1345	623759.93	1917202.98	636.19	633.2	ULA MW-01
1326	623917.73	1917163.13	636.97	633.9	ULA MW-02
1330	624017.95	1917082.01	636.80	633.7	ULA MW-03

Wastewater Treatment Plant #2 (May 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
554	623195.57	1911020.62	632.24	631.0	PZ-01
540	623108.02	1910684.85	641.47	638.4	PZ-02/SB-02
537	623144.69	1910827.50	640.32	637.8	PZ-03/SB-03
544	623058.08	1910992.40	633.38	631.7	PZ-04
549	623080.30	1910781.11	640.60	637.9	PZ-05/SB-05
564	622607.16	1910804.90	634.71	631.6	PZ-06/SB-06
541	623187.47	1910808.30	637.72		SB-01
538	623097.30	1910811.38	638.67		SB-04
542	623033.63	1910866.71	633.10		SB-07
550	622983.08	1910735.71	637.95		SB-08

Wastewater Treatment Plant #2 (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1429	623207.36	1910619.96	644.37	641.7	WWTP2 MW-01
1433	623085.26	1910791.36	640.39	637.8	WWTP2 MW-02
1437	623147.10	1910834.46	640.06	637.5	WWTP2 MW-03
1441	623044.98	1910991.57	635.02	631.9	WWTP2 MW-04

TNT Area C Sewer Line (May 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
552	622788.18	1910747.40	637.23	634.8	PZ-01/SB-01
556	622453.95	1910931.11	634.16	631.7	PZ-02/SB-02
558	622398.23	1910961.31	633.76	631.2	PZ-03/SB-03
560	622308.19	1910977.84	632.98	631.0	PZ-04/SB-04
562	622256.01	1911033.31	637.05	634.5	PZ-05/SB-05
570	621987.34	1911159.29	642.27	640.6	PZ-06/SB-06
572	621977.78	1911141.29	642.43	640.5	PZ-07/SB-07
566	621963.90	1911117.11	643.00	641.1	PZ-08/SB-08
574	621870.49	1911217.73	642.81	641.4	PZ-09/SB-09
576	621787.53	1911234.38	643.08	641.1	PZ-10/SB-10
578	621653.06	1911296.36	643.26	641.0	PZ-11/SB-11

TNT Area C Sewer Line (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1419	622408.93	1910955.79	634.01	631.4	TNTCSL MW-01
1414	621962.33	1911149.14	643.24	640.4	TNTCSL MW-02
1410	621457.27	1911382.57	645.19	642.6	TNTCSL MW-03

Steel Sewer Line (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1314	624207.78	1918010.06	635.11	631.7	SSL MW-01
1715	622883.53	1915564.71	638.96	635.9	SSL MW-02
1403	622637.39	1912719.90	640.63	637.7	SSL MW-03
1303	623886.12	1919381.30	636.39		SSL-TP1
1302	624009.95	1919173.97	638.01		SSL-TP2
1301	624073.83	1919068.79	636.98		SSL-TP3
1309	624152.86	1918928.22	633.47		SSL-TP4
1308	624153.15	1918615.50	633.86		SSL-TP5
1307	624159.13	1918372.96	632.97		SSL-TP6
1310	624163.81	1918020.97	632.14		SSL-TP7
1318	624175.91	1917084.86	632.51		SSL-TP8
1319	624177.58	1916916.80	633.52		SSL-TP9
1368	623956.34	1916571.69	634.21		SSL-TP11
1371	623585.64	1916234.80	632.54		SSL-TP12
1716	622874.51	1915562.57	636.12		SSL-TP13
1719	622755.28	1915453.34	638.07		SSL-TP14
1722	622571.26	1915283.29	639.46		SSL-TP15
1723	622574.78	1915168.09	637.75		SSL-TP16
1394	622605.96	1913620.05	640.77		SSL-TP17
1404	622623.59	1912721.64	637.37		SSL-TP18
1405	622632.23	1912646.98	637.76		SSL-TP19
1406	622629.17	1912619.75	638.07		SSL-TP20
1422	622610.61	1911714.53	639.71		SSL-TP21
1421	622652.39	1911593.26	639.63		SSL-TP22
1420	622656.36	1911533.51	640.26		SSL-TP23
1423	622655.95	1911264.17	630.28		SSL-TP24
1424	622657.42	1911187.19	631.10		SSL-TP25
1425	622658.15	1911118.09	631.57		SSL-TP26
1444	622674.01	1910717.04	634.20		SSL-TP27
1443	622674.85	1910643.89	634.22		SSL-TP28
1442	622861.59	1910645.64	642.45		SSL-TP30
1300	623927.48	1919565.67	638.27		SSLUTL-01
1369	623778.12	1916411.67	636.87		SSLUTL-02
1370	623694.24	1916334.79	635.88		SSLUTL-03
1706	623047.03	1915726.29	634.04		SSLUTL-04
1707	622976.47	1915659.23	633.97		SSLUTL-05
1709	623104.14	1915779.14	638.54	636.2	SSL-PZ02
1710	622891.58	1915551.55	638.84	635.8	SSL-PZ03
1718	622800.09	1915490.11	640.81	638.3	SSL-PZ04
1721	622733.22	1915418.55	640.92	638.9	SSL-PZ05

TNT Area A Sewer Line (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1457	624602.74	1921705.79	628.82		SLSB-02
1471	624326.70	1922541.92	630.17		SLSB-05
1472	624321.95	1922542.98	630.72		SLSB-11
1473	624328.53	1922551.60	630.25		SLSB-12
1474	624331.64	1922540.29	630.69		SLSB-13
1475	624325.12	1922532.16	630.64		SLSB-14
1452	624603.71	1921686.40	628.85		SLSB-15
1453	624608.61	1921697.12	628.87		SLSB-16
1454	624600.16	1921695.20	628.85		SLSB-17
1455	624608.15	1921706.14	628.70		SLSB-18
1456	624598.59	1921705.76	629.12		SLSB-19
1458	624605.09	1921717.51	628.79		SLSB-20
1459	624595.56	1921714.41	628.80		SLSB-21
1460	624600.20	1921724.09	628.47		SLSB-22
1461	624321.46	1922512.67	630.73		SLSB-23
1462	624333.58	1922551.28	630.73		SLSB-24
1463	624323.74	1922552.17	630.74		SLSB-25
1464	624336.76	1922570.87	630.79		SLSB-26
1465	624331.95	1922571.35	630.29		SLSB-27
1466	624327.14	1922571.94	630.66		SLSB-28
1467	624340.09	1922589.79	630.68		SLSB-29
1468	624335.01	1922590.95	630.37		SLSB-30
1469	624330.01	1922591.43	630.57		SLSB-31
1470	624338.73	1922610.57	630.27		SLSB-32

Ash Pit #3 (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1382	622910.53	1914684.10	638.03	638.5	AP3 MW-01
1379	622958.84	1914572.39	640.24	637.3	AP3 MW-02
1388	623077.56	1914421.69	639.28	636.2	AP3 MW-03

Acid Area #1 (September 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29) Adjacent Ground Elev.	Shaw Designation
1503	623078.28	1917106.10	638.42	AA1SS-01
1502	623076.73	1917171.83	638.44	AA1SS-02
1501	623075.70	1917246.79	638.55	AA1SS-03
1500	623039.17	1917293.39	638.66	AA1SS-04
1499	622984.40	1917293.03	638.45	AA1SS-05
1512	622954.08	1917229.01	639.05	AA1SS-06
1511	622955.77	1917164.58	639.23	AA1SS-07
1508	622956.83	1917089.10	639.38	AA1SS-08
1510	623001.76	1917066.77	638.34	AA1SS-09
1515	622887.69	1917172.92	639.32	AA1SS-10
1516	622907.05	1917233.67	639.03	AA1SS-11
1517	622881.62	1917304.26	637.83	AA1SS-12
1518	622814.45	1917329.70	638.00	AA1SS-13
1520	622707.29	1917340.43	638.81	AA1SS-14
1521	622704.30	1917231.64	639.59	AA1SS-15
1496	622975.86	1917587.10	638.45	AA1SS-16
1495	623037.08	1917589.53	637.75	AA1SS-17
1480	623064.78	1917704.91	639.12	AA1SS-18
1479	623065.08	1917637.67	638.31	AA1SS-19
1481	623061.83	1917804.59	638.68	AA1SS-20
1484	623034.78	1917834.69	638.79	AA1SS-21
1485	622967.39	1917835.92	638.45	AA1SS-22
1491	622930.15	1917771.74	639.63	AA1SS-23
1492	622932.71	1917708.65	639.61	AA1SS-24
1493	622932.60	1917633.33	639.48	AA1SS-25
1604	622853.23	1917648.95	637.16	AA1SS-26
1528	622885.14	1917706.18	638.86	AA1SS-27
1531	622854.06	1917806.49	638.63	AA1SS-28
1539	622847.55	1917891.08	638.74	AA1SS-29
1540	622856.20	1917976.35	638.90	AA1SS-30
1541	622842.99	1918045.69	638.99	AA1SS-31
1563	622887.57	1918118.44	639.50	AA1SS-32
1564	622871.73	1918216.54	639.13	AA1SS-33
1553	622718.83	1918169.12	639.00	AA1SS-34
1551	622689.36	1918097.34	639.17	AA1SS-35
1538	622734.26	1917941.52	638.97	AA1SS-36
1536	622731.20	1917882.54	638.98	AA1SS-37
1532	622745.39	1917809.30	639.30	AA1SS-38
1533	622743.92	1917731.23	639.22	AA1SS-39
1534	622680.36	1917678.76	638.85	AA1SS-40
1530	622763.83	1917641.77	637.77	AA1SS-41
1556	622682.28	1918569.02	640.38	AA1SS-42

Acid Area #1 (September 2011) <cont.>

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29) Adjacent Ground Elev.	Shaw Designation
1559	622763.35	1918563.10	639.48	AA1SS-43
1560	622863.21	1918513.54	639.33	AA1SS-44
1561	622877.63	1918588.87	640.14	AA1SS-45
1562	622835.66	1918657.90	641.27	AA1SS-46
1554	622762.05	1918053.62	639.05	AA1SS-47
1519	622766.70	1917335.77	638.24	AA1SS-48
1509	622993.80	1917064.17	634.75	AA1SS-49
1498	623073.71	1917303.80	638.33	AA1SS-50
1513	622960.42	1917323.23	634.30	AA1SS-51
1524	622880.86	1917372.21	636.65	AA1SS-52
1525	622817.11	1917387.41	636.81	AA1SS-53
1523	622718.26	1917391.44	637.72	AA1SS-54
1522	622654.66	1917361.08	639.01	AA1SS-55
1497	623070.51	1917436.15	638.27	AA1SS-56
1514	622976.12	1917448.41	635.40	AA1SS-57
1527	622789.91	1917432.10	636.82	AA1SS-58
1526	622860.52	1917484.11	636.20	AA1SS-59
1478	623066.03	1917555.87	638.37	AA1SS-60
1494	622947.89	1917558.68	639.17	AA1SS-61
1529	622821.39	1917639.93	637.26	AA1SS-62
1482	623057.97	1917895.33	638.61	AA1SS-63
1486	623007.09	1917906.72	637.40	AA1SS-64
1487	622973.47	1917899.89	637.77	AA1SS-65
1490	622942.18	1917877.79	638.98	AA1SS-66
1535	622691.85	1917886.00	639.52	AA1SS-67
1483	623053.10	1917979.40	638.31	AA1SS-68
1488	623006.56	1917959.29	636.95	AA1SS-69
1489	622941.52	1917963.82	638.03	AA1SS-70
1537	622690.45	1917944.62	639.31	AA1SS-71
1552	622678.71	1918186.89	638.95	AA1SS-72
1565	622869.25	1918282.09	638.99	AA1SS-73
1555	622685.10	1918492.13	640.51	AA1SS-74
1557	622618.06	1918574.96	640.05	AA1SS-75
1558	622699.47	1918653.16	640.08	AA1SS-76

Acid Area #1 (November 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1596	622702.09	1917439.32	637.52		AA1SS-77
1595	622650.07	1917422.19	638.74		AA1SS-78
1598	622648.39	1917885.23	639.34		AA1SS-79
1597	622650.25	1917964.73	638.95		AA1SS-80
1600	622745.55	1918688.23	639.71		AA1SS-81
1601	622692.32	1918741.84	640.68		AA1SS-82
1602	622639.59	1918661.45	640.79		AA1SS-83
1592	623121.40	1917266.85	639.48		AA1SS-84
1591	623133.18	1917184.05	639.34		AA1SS-85
1594	622575.71	1917360.29	637.60		AA1SS-86
1599	622560.41	1917915.86	637.94		AA1SS-87
1603	622637.03	1918781.36	640.23		AA1SS-88

Coal Yard #1 (November 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1586	623312.31	1918693.70	640.31		COAL1-SB01
1587	623317.59	1918784.80	640.42		COAL1-SB02
1589	623280.45	1918610.43	636.99		COAL1-SB03
1590	623344.70	1918544.11	636.46		COAL1-SB04

Coal Yard #2 (November 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1585	623081.60	1911875.80	637.87		COAL2-SB01
1584	623034.37	1911903.68	638.12		COAL2-SB02
1582	623066.83	1911941.56	638.10		COAL2-SB03
1583	623069.44	1911988.57	637.94		COAL2-SB04

Coal Yard #3 (November 2011)

SS&M Pt. #	N(y) - NAD 83/95 Ohio State Plane	E(x) - NAD 83/95 North Zone	Elev (NGVD 29)	Adjacent Ground Elev.	Shaw Designation
1580	622941.18	1914858.88	639.33		COAL3-SB01
1578	622897.02	1914797.95	639.11		COAL3-SB02
1579	622921.16	1914832.59	639.18		COAL3-SB03
1581	622870.43	1914828.65	639.16		COAL3-SB04

APPENDIX E

INVESTIGATION-DERIVED WASTE MANIFEST

008257716JJK

Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number: OH3 800 015 379
2. Page 1 of: 1
3. Emergency Response Phone: (800) 255-3924
4. Manifest Tracking Number: 008257716 JJK

5. Generator's Name and Mailing Address: NASA - PLUMBROOK STATION
6100 COLUMBUS AVE
SANDUSKY, OH 44870
Generator's Phone: (419) 621-3234
Generator's Site Address (if different than mailing address):

6. Transporter 1 Company Name: EQ INDUSTRIAL SERVICES
U.S. EPA ID Number: MID 000 263 871

7. Transporter 2 Company Name:
U.S. EPA ID Number:

8. Designated Facility Name and Site Address: EQ DETROIT, INC.
1923 FREDERICK
DETROIT, MI 48211
Facility's Phone: (313) 347-1300
U.S. EPA ID Number: MID 980 991 566

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1. NON DOT HAZARDOUS, NON RCRA REGULATED	008	DM	440	G	D281
	2. NON DOT HAZARDOUS, NON RCRA REGULATED	035	DM	17,500	P	
	3.					
	4.					

14. Special Handling Instructions and Additional Information
1. D088220DET / NON HAZARDOUS IDW WATER 2. D088221DET / NON HAZARDOUS SOIL

NASA # N11517 TR 12451 WID 1132400

15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: Robert F. Lallier Jr
Signature: Robert F. Lallier on behalf of NASA
Month 10 Day 18 Year 11

16. International Shipments: ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

17. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: DAVE BLAIR
Signature: Dave Blair
Month 10 Day 18 Year 11
Transporter 2 Printed/Typed Name:
Signature:
Month Day Year

18. Discrepancy
18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
Manifest Reference Number:
18b. Alternate Facility (or Generator)
U.S. EPA ID Number
Facility's Phone:
18c. Signature of Alternate Facility (or Generator)
Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)
1. LIW 2. LIW 3. 4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a
Printed/Typed Name: Tammy J. Ihrke
Signature: Tammy Ihrke
Month 10 Day 18 Year 11

GENERATOR — INTL — TRANSPORTER — DESIGNATED FACILITY

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

009108643JJK

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number: OH3 800 015 379
2. Page 1 of 1
3. Emergency Response Phone: (800) 255-3924
4. Manifest Tracking Number: 009108643 JJK

5. Generator's Name and Mailing Address: NASA - PLUMBROOK STATION
6100 COLUMBUS AVE
SANDUSKY, OH 44870
Generator's Phone: (419) 621-3234

Generator's Site Address (if different than mailing address):
6100 COLUMBUS AVE
SANDUSKY, OH 44870

6. Transporter 1 Company Name: TRIAD TRANSPORT, INC.
U.S. EPA ID Number: OKD 981 588 791

7. Transporter 2 Company Name:
U.S. EPA ID Number:

8. Designated Facility Name and Site Address: EQ DETROIT, INC.
1923 FREDERICK
DETROIT, MI 48211
Facility's Phone: (313) 347-1300
U.S. EPA ID Number: MID 980 991 566

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	1. NON DOT HAZARDOUS, NON RCRA REGULATED	35	DM	1800	G	029L
	2.					
	3.					
	4.					

14. Special Handling Instructions and Additional Information
01. D098220DET / NON HAZARDOUS IDW WATER

NASA # N12002

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: Robert F. Lallier Jr.
Signature: Robert Lallier on behalf of NASA GRC
Month 12 Day 26 Year 12

16. International Shipments ☐ Import to U.S. ☐ Export from U.S.
Transporter signature (for exports only):
Port of entry/exit:
Date leaving U.S.:

17. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: MARK R. SMEALLIE
Signature: Mark R Smeallie
Month 1 Day 26 Year 12

Transporter 2 Printed/Typed Name:
Signature:
Month Day Year

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

18b. Alternate Facility (or Generator)
Manifest Reference Number:
U.S. EPA ID Number
Facility's Phone:

18c. Signature of Alternate Facility (or Generator)
Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)
1. LIW 2. 3. 4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a
Printed/Typed Name: Julie Denzich
Signature:
Month 1 Day 10 Year 12

GENERATOR | INT'L | TRANSPORTER | DESIGNATED FACILITY

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

APPENDIX F

DATA VALIDATION SUMMARIES

MARCH 2012
COAL YARD 3
DATA QUALITY EVALUATION

Data Validation Summary Report
Coal Yard 3 Sampling December 2011
Former Plum Brook Ordnance Works
Sandusky, Ohio

1.0 Introduction

Level IV data validation was performed on 100 percent of the environmental soil samples collected for the December 2011 sampling events. The analytical data consisted of one sample delivery group (F88938) analyzed by Accutest Laboratory of Orlando, Florida. In addition, validation was performed on the field split samples in SDG (240-7168-1 - Test America) and the findings are discussed in section 5.0 of this report.

The following samples were validated for this investigation:

SDG Number	Sample Number
F88938	CY0031, CY0032, CY0033, CY0035, CY0036, CY0037, CY0038, CY0039, CY0040, CY0041, CY0042, CY0043, CY0044
240-7168-1	CY0034

The chemical parameters, for which the samples were analyzed, are identified below:

Parameter (Prep/Analytical Method)
Semivolatile Organics by GC/MS SW846 3550C/8270D
Total and Dissolved Metals by SW846 3050B/6010C and 7471B
Nitroaromatic and Nitramine Explosives by SW846 8330A
PCBs by SW846 3550C/8082A
Wet Chemistry (TOC)

GC/MS – Gas chromatography/mass spectrometry. TOC - Total organic carbon.

2.0 Procedures

The sample data were validated following the logic identified in the EPA Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review (October 2004) and the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Review (June 2008) for all areas except blanks. EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (April 1993) and Region III Modifications to National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration (September 1994) were applied to the areas associated with blank contamination. Specific quality control (QC) criteria as identified in the quality assurance plan (QAP), analytical methods, and laboratory standard operating procedures (SOP) were applied to all sample results. As a result of the use of Update III SW846 test methods for the analytical data and the application of the Contract Laboratory Program (CLP) guidelines during the validation process, there were instances where the specific QC requirements for all target compounds were not defined. This primarily occurred in the organic, GC/MS calibration areas and is due to the fact that the analytical methods are performance-based and allow the use of average calibration responses in lieu of individual responses, which are defined by CLP protocol. In light of applying CLP guidelines to SW846 methods and evaluating the usability of the data

during the validation process, specific QC criteria were determined to address all target compounds and are identified in this report for each parameter, as well as in the validation checklists, which function as worksheets. For those analytical methods not addressed by the CLP and Region III guidelines, the validation was based on the method requirements (i.e., SW846, Code of Federal Regulations, SOPs) and technical judgment, following the logic of the CLP validation guidelines. Lab-specific criteria may be found in Attachment A.

3.0 Summary of Data Validation Findings

The overall quality of the data was determined to be acceptable with minimal qualifications. An individual validation report has been prepared for the parameters analyzed, and the overall results of the validation findings are summarized in this report. A listing of the validation qualifiers and the reason codes, along with their definitions, is found in Attachment A. The following section highlights the key findings of the data validation process. No data were rejected.

4.0 Analysis-Specific Data Validation Summaries

4.1 Semivolatile Organics by GC/MS SW846 8270C

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Sample Preservation

Sample preservation criteria were met for all samples.

Initial and Continuing Calibration

The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks

The 5X/10X rule for contaminants found in the associated equipment rinses and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries

All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Sample(s) Affected	Analyte(s)	Validation Qualifier
F88938	CY0040	Benzoic Acid, Isophorone	UJ

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Internal Standards
All internal standards met QC criteria.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.2 Total and Dissolved Metals by SW846 6010B/7470A/7471
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times
Technical holding time criteria were met for all samples.

Sample Preservation
Sample preservation criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Sample(s) Affected	Analyte(s)	Validation Qualifier
F88938	CY0040	Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Magnesium, Nickel, Potassium, Selenium, Silver, Sodium, Vanadium, Zinc	J/UJ

Laboratory Duplicate Sample Analysis
A Laboratory Duplicate Sample analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Samples Affected	Analyte(s)	Validation Qualifier
F88938	CY0040	Calcium, Manganese	J

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Interference Check Sample
All Interference Check Sample (ICS) percent recoveries were met.

Inductively Coupled Plasma Serial Dilutions
All QC criteria were met for the serial dilutions associated with the project samples with the following exception(s):

SDG	Sample(s) Affected	Analyte(s)	Validation Qualifier
F88938	CY0040	Aluminum, Arsenic, Barium, Beryllium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Vanadium, Zinc	J

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified with the following exception(s):

SDG	Samples Affected	Analyte(s)	Validation Qualifier
F88938	CY0032(original), CY0033(FD)	Mercury	J

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as “B”, were qualified as estimated “J” unless blank contamination was present or the results were rejected.

4.3 Nitroaromatic and Nitroamine Explosives by SW846 8330A
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times
Technical holding time criteria were met for all samples.

Sample Preservation
Sample preservation criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Second Column Confirmation
Samples having analytes with positive detects were verified on a second confirmation column; QC criteria (40% RPD) were met.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.4 Polychlorinated Biphenyls (PCBs) by SW846 8082
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times
Technical holding time criteria were met for all samples.

Sample Preservation
Sample preservation criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits for all the project samples.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Second Column Confirmation
Samples having analytes with positive detects were verified on a second confirmation column; QC criteria (40% RPD) were met.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.5 Wet Chemistry (TOC)
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times
Technical holding time criteria were met for all samples.

Sample Preservation
Sample preservation criteria were met for all samples.

Initial and Continuing Calibration
All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks
The 5X rule for contaminants found in the associated equipment rinses and method blanks was applied to all sample results. All were found to be acceptable.

Matrix Spike/Matrix Spike Duplicate
MS/MSD analysis was performed for the project samples, and all QC criteria were met.

Laboratory Duplicate Sample Analysis
A Laboratory Duplicate Sample analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
LCS analysis was performed for the project samples, and all QC criteria were met.

Field Duplicates
There were no original and field duplicate samples analyzed for the wet chemistry parameters.

Quantitation
Results quantified between the MDL and RL which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.0 Quality Assurance Field Split Sample Data Evaluation

Data from the quality assurance split sample, CY0010 (SDG: 240-7168-1), were validated. The field split (FS) sample was analyzed for Semivolatiles by SW846 8270C, Explosives by SW846 8330, Polychlorinated Biphenyls (PCBs) by SW846 8280 and Total and Dissolved Metals by SW 846 6010B and 7471A. The following section highlights the key findings of the data validation for each analysis.

The following samples were validated for this site investigation:

SDG Number	Sample Number
240-7168-1	CY0034

Sample/FD/FS
CY0032 (Original) / CY0033 (FD) / CY0034 (FS)

5.1 Semivolatile Organics by GC/MS SW846 8270C

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times
Technical holding time criteria were met for all samples.

Sample Preservation
Sample preservation criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and

method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries

All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample

Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Internal Standards

All internal standards met QC criteria.

Field Splits

Table 2 shows the Regular/Field Duplicate/Field Split comparison of the data. A Relative Percent Difference is calculated for the analytes that were positive detects.

Quantitation

Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.2 Total and Dissolved Metals by SW846 6010B/7470A/7471

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Sample Preservation

Sample preservation criteria were met for all samples.

Initial and Continuing Calibration

The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks

The 5X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Matrix Spike/Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Sample(s) Affected	Analyte(s)	Validation Qualifier
240-7168-1	CY0034	Calcium, Chromium, Copper, Manganese, Antimony, Zinc	J/UJ

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Interference Check Sample
All Interference Check Sample (ICS) percent recoveries were acceptable. All QC criteria were met.

Inductively Coupled Plasma Serial Dilutions
All QC criteria were met for the serial dilutions associated with the project samples.

Field Splits
Table 2 shows the Regular/Field Duplicate/Field Split comparison of the data. A Relative Percent Difference is calculated for the analytes that were positive detects.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "B", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.3 Nitroaromatic and Nitroamine Explosives by SW846 8330
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times
Technical holding time criteria were met for all samples.

Sample Preservation
Sample preservation criteria were met for all samples.
Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits for the project samples.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Second Column Confirmation
Samples having analytes with positive detects were verified on a second confirmation column; QC criteria (40% RPD) were met.

Field Splits
Table 2 shows the Regular/Field Duplicate/Field Split comparison of the data. A Relative Percent Difference is calculated for the analytes that were positive detects.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.4 Polychlorinated Biphenyls (PCBs) by SW846 8082
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times
Technical holding time criteria were met for all samples.

Sample Preservation
Sample preservation criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Second Column Confirmation
Samples having analytes with positive detects were verified on a second confirmation column; QC criteria (40% RPD) were met.

Field Splits
Table 2 shows the Regular/Field Duplicate/Field Split comparison of the data. A Relative Percent Difference is calculated for the analytes that were positive detects.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

Laboratory Control Limits for QC Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio

Spiked Compound	Accutest			Test America		
	Soil - LCS	Soil - MS/MSD		Soil - LCS	Soil - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)	% Recovery Range	% Recovery Range	Precision RPD (%)
Volatile Organic Compounds, SW846 8260B						
Acetone	61 - 144	61 - 144	29	N/A	N/A	N/A
Acrolein	N/A	N/A	N/A	N/A	N/A	N/A
Acrylonitrile	N/A	N/A	N/A	N/A	N/A	N/A
Benzene	78 - 130	78 - 130	25	75 - 129	75 - 129	N/A
Bromobenzene	N/A	N/A	N/A	N/A	N/A	N/A
Bromochloromethane	N/A	N/A	N/A	N/A	N/A	N/A
Bromodichloromethane	73 - 122	73 - 122	25	N/A	N/A	N/A
Bromoform	70 - 139	70 - 139	26	N/A	N/A	N/A
Bromomethane	N/A	N/A	N/A	N/A	N/A	N/A
2-Butanone	N/A	N/A	N/A	N/A	N/A	N/A
Chlorobenzene	83 - 122	83 - 122	23	75 - 127	75 - 127	N/A
Chloroethane	61 - 153	61 - 153	31	N/A	N/A	N/A
Chloromethane	N/A	N/A	N/A	N/A	N/A	N/A
Chloroform	79 - 129	79 - 129	27	N/A	N/A	N/A
2-Chlorotoluene	N/A	N/A	N/A	N/A	N/A	N/A
4-Chlorotoluene	N/A	N/A	N/A	N/A	N/A	N/A
Carbon disulfide	61 - 142	61 - 142	27	N/A	N/A	N/A
Carbon tetrachloride	79 - 135	79 - 135	29	N/A	N/A	N/A
1,2-Dibromoethane	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dibromo-3-chloropropane	N/A	N/A	N/A	N/A	N/A	N/A
1,1-Dichloroethane	77 - 132	77 - 132	26	N/A	N/A	N/A
1,1-Dichloroethylene	66 - 132	66 - 132	27	55 - 142	55 - 142	N/A
1,2-Dichloroethane	78 - 129	78 - 129	24	N/A	N/A	N/A
1,2-Dichloropropane	74 - 127	74 - 127	27	N/A	N/A	N/A
1,3-Dichloropropane	N/A	N/A	N/A	N/A	N/A	N/A
2,2-Dichloropropane	N/A	N/A	N/A	N/A	N/A	N/A
1,1-Dichloropropene	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dichlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A
1,3-Dichlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A
1,4-Dichlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A
Dibromochloromethane	78 - 117	78 - 117	27	N/A	N/A	N/A
Dibromomethane	N/A	N/A	N/A	N/A	N/A	N/A
Dichlorodifluoromethane	N/A	N/A	N/A	N/A	N/A	N/A

Laboratory Control Limits for QC Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio

Spiked Compound	Accutest			Test America		
	Soil - LCS	Soil - MS/MSD		Soil - LCS	Soil - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)	% Recovery Range	% Recovery Range	Precision RPD (%)
cis-1,2-Dichloroethylene	74 - 123	74 - 123	26	N/A	N/A	N/A
cis-1,3-Dichloropropene	79 - 130	79 - 130	23	N/A	N/A	N/A
trans-1,2-Dichloroethylene	77 - 129	77 - 129	27	N/A	N/A	N/A
trans-1,3-Dichloropropene	87 - 131	87 - 131	27	N/A	N/A	N/A
Ethylbenzene	82 - 124	82 - 124	25	N/A	N/A	N/A
2-Hexanone	67 - 130	67 - 130	29	N/A	N/A	N/A
Hexachlorobutadiene	N/A	N/A	N/A	N/A	N/A	N/A
Isopropylbenzene	N/A	N/A	N/A	N/A	N/A	N/A
4-Isopropyltoluene	N/A	N/A	N/A	N/A	N/A	N/A
4-Methyl-2-pentanone	69 - 125	69 - 125	24	N/A	N/A	N/A
Methyl bromide	60 - 146	60 - 146	31	N/A	N/A	N/A
Methyl chloride	58 - 163	58 - 163	26	N/A	N/A	N/A
Methylene chloride	62 - 140	62 - 140	25	N/A	N/A	N/A
Methyl ethyl ketone	66 - 134	66 - 134	23	N/A	N/A	N/A
Methyl tert-Butyl ether	N/A	N/A	N/A	N/A	N/A	N/A
Naphthalene	N/A	N/A	N/A	N/A	N/A	N/A
n-Butylbenzene	N/A	N/A	N/A	N/A	N/A	N/A
n-Propylbenzene	N/A	N/A	N/A	N/A	N/A	N/A
Styrene	79 - 123	79 - 123	28	N/A	N/A	N/A
sec-Butylbenzene	N/A	N/A	N/A	N/A	N/A	N/A
1,1,1-Trichloroethane	80 - 133	80 - 133	27	N/A	N/A	N/A
1,2,3-Trichloropropane	N/A	N/A	N/A	N/A	N/A	N/A
1,1,1,2-Tetrachloroethane	N/A	N/A	N/A	N/A	N/A	N/A
1,1,2,2-Tetrachloroethane	70 - 128	70 - 128	30	N/A	N/A	N/A
1,1,2-Trichloroethane	76 - 118	76 - 118	28	N/A	N/A	N/A
1,3,5-Trimethylbenzene	N/A	N/A	N/A	N/A	N/A	N/A
1,2,3-Trichlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A
1,2,4-Trichlorobenzene	N/A	N/A	N/A	N/A	N/A	N/A
1,2,4-Trimethylbenzene	N/A	N/A	N/A	N/A	N/A	N/A
tert-Butylbenzene	N/A	N/A	N/A	N/A	N/A	N/A
Tetrachloroethylene	79 - 132	79 - 132	27	N/A	N/A	N/A
Toluene	80 - 123	80 - 123	26	71 - 130	71 - 130	N/A
Trichloroethylene	78 - 132	78 - 132	28	70 - 131	70 - 131	N/A
Trichlorofluoromethane	N/A	N/A	N/A	N/A	N/A	N/A
Vinyl acetate	N/A	N/A	N/A	N/A	N/A	N/A

Laboratory Control Limits for QC Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio

Spiked Compound	Accutest			Test America		
	Soil - LCS	Soil - MS/MSD		Soil - LCS	Soil - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)	% Recovery Range	% Recovery Range	Precision RPD (%)
Vinyl chloride	60 - 145	60 - 145	29	N/A	N/A	N/A
m-Xylene/p-Xylene	N/A	N/A	N/A	N/A	N/A	N/A
o-Xylene	N/A	N/A	N/A	N/A	N/A	N/A
Xylene (total)	83 - 127	83 - 127	24	N/A	N/A	N/A
Surrogates						
Dibromofluoromethane	80 - 121	80 - 121	N/A	68-110	68-110	N/A
Toluene-D8	71 - 130	71 - 130	N/A	69-128	69-128	N/A
4-Bromofluorobenzene	59 - 148	59 - 148	N/A	64-130	64-130	N/A
1,2-Dichloroethane-D4	77 - 123	77 - 123	N/A	64-130	64-130	N/A
Semivolatile Organic Compounds, SW-846 8270C						
Benzoic Acid	44 - 116	44 - 116	36	N/A	N/A	N/A
2-Chlorophenol	54 - 97	54 - 97	31	32 - 110	32 - 110	30
4-Chloro-3-methyl phenol	59 - 102	59 - 102	27	32 - 117	32 - 117	30
2,4-Dichlorophenol	60 - 101	60 - 101	30	N/A	N/A	N/A
2,4-Dimethylphenol	49 - 89	49 - 89	31	N/A	N/A	N/A
2,4-Dinitrophenol	39 - 107	39 - 107	40	N/A	N/A	N/A
4,6-Dinitro-o-cresol	58 - 109	58 - 109	37	N/A	N/A	N/A
2-Methylphenol	53 - 94	53 - 94	29	N/A	N/A	N/A
3&4-Methylphenol	54 - 95	54 - 95	31	N/A	N/A	N/A
4-Methylphenol	N/A	N/A	N/A	N/A	N/A	N/A
2-Nitrophenol	55 - 96	55 - 96	30	N/A	N/A	N/A
4-Nitrophenol	56 - 106	56 - 106	29	10 - 125	10 - 125	30
Pentachlorophenol	50 - 115	50 - 115	33	10 - 182	10 - 182	30
Phenol	55 - 99	55 - 99	28	10 - 144	10 - 144	30
2,4,5-Trichlorophenol	60 - 101	60 - 101	28	N/A	N/A	N/A
2,4,6-Trichlorophenol	60 - 100	60 - 100	27	N/A	N/A	N/A
Acenaphthene	59 - 97	59 - 97	29	10 - 200	10 - 200	30
Acenaphthylene	58 - 98	58 - 98	30	N/A	N/A	N/A
Anthracene	61 - 104	61 - 104	29	N/A	N/A	N/A
Benzo(a)anthracene	60 - 106	60 - 106	31	N/A	N/A	N/A
Benzo(a)pyrene	59 - 102	59 - 102	32	N/A	N/A	N/A
Benzo(b)fluoranthene	60 - 107	60 - 107	31	N/A	N/A	N/A
Benzo(g,h,i)perylene	56 - 103	56 - 103	32	N/A	N/A	N/A
Benzo(k)fluoranthene	61 - 107	61 - 107	30	N/A	N/A	N/A

Laboratory Control Limits for QC Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio

Spiked Compound	Accutest			Test America		
	Soil - LCS	Soil - MS/MSD		Soil - LCS	Soil - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)	% Recovery Range	% Recovery Range	Precision RPD (%)
4-Bromophenol phenyl ether	60 - 104	60 - 104	26	N/A	N/A	N/A
Butyl benzyl phthalate	57 - 110	57 - 110	28	N/A	N/A	N/A
Benzyl Alcohol	N/A	N/A	N/A	N/A	N/A	N/A
Butyl Alcohol	51 - 102	51 - 102	34	N/A	N/A	N/A
2-Chloronaphthalene	57 - 95	57 - 95	28	N/A	N/A	N/A
4-Chloroaniline	19 - 85	19 - 85	34	N/A	N/A	N/A
Carbazole	60 - 106	60 - 106	30	N/A	N/A	N/A
Chrysene	60 - 107	60 - 107	31	N/A	N/A	N/A
bis(2-Chloroethyoxy)methane	51 - 89	51 - 89	30	N/A	N/A	N/A
bis(2-Chloroethyl)ether	50 - 96	50 - 96	33	N/A	N/A	N/A
bis(2-Chloroisopropyl)ether	44 - 94	44 - 94	32	N/A	N/A	N/A
4-Chlorophenyl phenyl ether	60 - 101	60 - 101	26	N/A	N/A	N/A
1,2-Dichlorobenzene	47 - 91	47 - 91	35	N/A	N/A	N/A
1,3-Dichlorobenzene	45 - 86	45 - 86	36	N/A	N/A	N/A
1,4-Dichlorobenzene	45 - 88	45 - 88	36	26 - 110	26 - 110	30
2,4-Dinitrotoluene	59 - 103	59 - 103	30	42 - 118	42 - 118	30
2,6-Dinitrotoluene	57 - 99	57 - 99	30	N/A	N/A	N/A
3,3'-Dichlorobenzidine	34 - 88	34 - 88	31	N/A	N/A	N/A
Dibenzo(a,h)antracene	57 - 105	57 - 105	29	N/A	N/A	N/A
Dibenzofuran	58 - 103	58 - 103	27	N/A	N/A	N/A
Di-n-butyl phthalate	59 - 105	59 - 105	27	N/A	N/A	N/A
Di-n-octyl phthalate	59 - 117	59 - 117	28	N/A	N/A	N/A
Diethyl phthalate	59 - 106	59 - 106	27	N/A	N/A	N/A
Dimethyl phthalate	60 - 100	60 - 100	26	N/A	N/A	N/A
bis(2-Ethylhexyl)phthalate	57 - 111	57 - 111	29	N/A	N/A	N/A
Fluoranthene	60 - 110	60 - 110	32	N/A	N/A	N/A
Fluorene	60 - 99	60 - 99	30	N/A	N/A	N/A
Hexachlorobenzene	58 - 103	58 - 103	27	N/A	N/A	N/A
Hexachlorobutadiene	49 - 95	49 - 95	33	N/A	N/A	N/A
Hexachlorocyclopentadiene	36 - 94	36 - 94	41	N/A	N/A	N/A
Hexachloroethane	44 - 89	44 - 89	38	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	57 - 104	57 - 104	33	N/A	N/A	N/A
Isophorone	58 - 97	58 - 97	30	N/A	N/A	N/A
2-Methylnaphthalene	57 - 103	57 - 103	32	N/A	N/A	N/A
2-Nitroaniline	53 - 106	53 - 106	29	N/A	N/A	N/A

Laboratory Control Limits for QC Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio

Spiked Compound	Accutest			Test America		
	Soil - LCS	Soil - MS/MSD		Soil - LCS	Soil - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)	% Recovery Range	% Recovery Range	Precision RPD (%)
3-Nitroaniline	29 - 85	29 - 85	31	N/A	N/A	N/A
4-Nitroaniline	49 - 104	49 - 104	31	N/A	N/A	N/A
Naphthalene	54 - 93	54 - 93	32	N/A	N/A	N/A
Nitrobenzene	53 - 92	53 - 92	32	N/A	N/A	N/A
N-Nitroso-di-n-propylamine	49 - 94	49 - 94	28	30 - 121	30 - 121	30
N-Nitrosodimethylamine	N/A	N/A	N/A	N/A	N/A	N/A
N-Nitrosodiphenylamine	53 - 107	53 - 107	28	N/A	N/A	N/A
Phenanthrene	61 - 103	61 - 103	32	N/A	N/A	N/A
Pyrene	58 - 109	58 - 109	33	10 - 200	10 - 200	30
Diphenylamine	N/A	N/A	N/A	N/A	N/A	N/A
1,2,4-Trichlorobenzene	52 - 93	52 - 93	32	33 - 110	33 - 110	30
Surrogates						
2-Fluorophenol	40 - 102	40 - 102	N/A	35-105	35-105	N/A
Phenol-d5	41 - 100	41 - 100	N/A	40-100	40-100	N/A
2,4,6-Tribromophenol	42 - 108	42 - 108	N/A	35-125	35-125	N/A
Nitrobenzene-d5	40 - 105	40 - 105	N/A	35-100	35-100	N/A
2-Fluorobiphenyl	43 - 107	43 - 107	N/A	45-105	45-105	N/A
Terphenyl-d14	45 - 119	45 - 119	N/A	30-125	30-125	N/A
Nitroaromatics and Nitroamines, SW-846 8330						
HMX	75 - 156	75 - 156	27	75 - 125	75 - 125	N/A
RDX	77 - 131	77 - 131	28	70 - 135	70 - 135	N/A
1,3-Dinitrobenzene	82 - 134	82 - 134	20	80 - 125	80 - 125	N/A
2,6-Dinitrotoluene	86 - 142	86 - 142	17	80 - 120	80 - 120	N/A
2,4-Dinitrotoluene	74 - 129	74 - 129	18	80 - 125	80 - 125	N/A
2-amino-4,6-Dinitrotoluene	83 - 123	83 - 123	22	80 - 125	80 - 125	N/A
4-amino-2,6-Dinitrotoluene	85 - 137	85 - 137	18	80 - 125	80 - 125	N/A
Nitrobenzene	82 - 138	82 - 138	19	75 - 125	75 - 125	N/A
o-Nitrotoluene	85 - 129	85 - 129	21	75 - 120	75 - 120	N/A
m-Nitrotoluene	85 - 136	85 - 136	22	80 - 125	80 - 125	N/A

Laboratory Control Limits for QC Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio

Spiked Compound	Accutest			Test America		
	Soil - LCS	Soil - MS/MSD		Soil - LCS	Soil - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)	% Recovery Range	% Recovery Range	Precision RPD (%)
p-Nitrotoluene	86 - 133	86 - 133	19	75 - 125	75 - 125	N/A
Tetryl	53 - 124	53 - 124	22	10 - 150	10 - 150	N/A
1,3,5-Trinitrobenzene	81 - 138	81 - 138	24	75 - 125	75 - 125	N/A
2,4,6-Trinitrotoluene	70 - 137	70 - 137	29	55 - 140	55 - 140	N/A
Surrogates						
3,4-Dinitrotoluene	72 - 145	72 - 145	N/A	78-108	78-108	N/A
PCBs, SW-846 8082						
Aroclor-1016	69 - 117	69 - 117	26	10 - 199	10 - 199	30
Aroclor-1260	71 - 121	71 - 121	30	10 - 199	10 - 199	30
Surrogates						
Tetrachloro-m-xylene	44 - 126	44 - 126	N/A	40-140	40-140	N/A
Decachlorobiphenyl	39 - 157	39 - 157	N/A	60-125	60-125	N/A
Metals, SW-846 6010B/7470A						
Aluminum	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Antimony	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Arsenic	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Barium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Beryllium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Cadmium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Calcium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Chromium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Cobalt	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Copper	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Iron	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Lead	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Magnesium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Manganese	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Nickel	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Potassium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Selenium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Silver	80 - 120	80 - 120	20	80 - 120	75 - 125	20

Laboratory Control Limits for QC Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio

Spiked Compound	Accutest			Test America		
	Soil - LCS	Soil - MS/MSD		Soil - LCS	Soil - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)	% Recovery Range	% Recovery Range	Precision RPD (%)
Sodium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Thallium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Vanadium	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Zinc	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Mercury	80 - 120	80 - 120	20	80 - 120	75 - 125	20
Total Organic Carbon (TOC) SW-846 9060						
TOC			25			

LCS - Laboratory Control Sample
MS/MSD - Matrix Spike/Matrix Spike Duplicate
RPD - Relative Percent Difference
N/A - Not Applicable

SEPTEMBER 2012
ASH PIT 3 SAMPLING
DATA QUALITY EVALUATION

Data Validation Summary Report
Ash Pit 3 Sampling August 2009 – May 2012
Former Plum Brook Ordnance Works
Sandusky, Ohio

1.0 Introduction

Level IV data validation was performed on 100 percent of the environmental samples collected for the December 2011 and May 2012 groundwater sampling events. The analytical data consisted of three sample delivery groups (F88782, F88900 and F93578) analyzed by Accutest Laboratory of Orlando, Florida. In addition, the field-split data for SDG 240-7113-1 analyzed by Test America was validated and the findings are discussed in section 5.0 of this report. Water matrices were validated.

The following samples were validated for this investigation:

SDG Number	Sample Number
F88782	AP3086
F88900	AP3083, AP3084, AP3087
F93578	AP3088, AP3091, AP3092
240-7113-1	AP3085

*Sample AP2011 collected on 05/23/09 was received broken; Sample AP2011A was collected 5/27/09.

The chemical parameters, for which the samples were analyzed, are identified below:

Parameter (Prep/Analytical Method)
Volatile Organics by GC/MS SW846 5030/8260B
Semivolatile Organics by GC/MS SW846 3510C/8270C
Total and Dissolved Metals by SW846 3005A/6010B and 7470A/7471
Nitroaromatic and Nitramine Explosives by 3535A/SW846 8330A
Polychlorinated Biphenyls by 3510C/SW846 8082
Wet Chemistry (TOC, Sulfate, Nitrate, Chloride, Alkalinity, Turbidity, TDS, TSS, Hardness, Cyanide)

GC/MS – Gas chromatography/mass spectrometry.
TDS - Total dissolved solids.
TOC - Total organic carbon.
TSS – Total suspended solids.

2.0 Procedures

The sample data were validated following the logic identified in the EPA Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review (October 2004) and the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Review (June 2008) for all areas except blanks. EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (April 1993) and Region III Modifications to National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration (September 1994) were applied to the areas associated with blank contamination. Specific quality control (QC) criteria as identified in the quality assurance plan

(QAP), analytical methods, and laboratory standard operating procedures (SOP) were applied to all sample results. As a result of the use of Update III SW846 test methods for the analytical data and the application of the Contract Laboratory Program (CLP) guidelines during the validation process, there were instances where the specific QC requirements for all target compounds were not defined. This primarily occurred in the organic, GC/MS calibration areas and is due to the fact that the analytical methods are performance-based and allow the use of average calibration responses in lieu of individual responses, which are defined by CLP protocol. In light of applying CLP guidelines to SW846 methods and evaluating the usability of the data during the validation process, specific QC criteria were determined to address all target compounds and are identified in this report for each parameter, as well as in the validation checklists, which function as worksheets. For those analytical methods not addressed by the CLP and Region III guidelines, the validation was based on the method requirements (i.e., SW846, Code of Federal Regulations, SOPs) and technical judgment, following the logic of the CLP validation guidelines. Lab-specific criteria may be found in Attachment A.

3.0 Summary of Data Validation Findings

The overall quality of the data was determined to be acceptable with minimal qualifications. The only rejected data ("R" qualified) was due to more than one set of results for Alkalinity being assigned to the sample AP3085. One of the results was rejected to indicate that a given result should not be used to characterize a particular constituent or an analysis for that given sample.

Individual validation reports have been prepared for each parameter, and the overall results of the validation findings are summarized in this report. A listing of the validation qualifiers and the reason codes, along with their definitions, is found in Attachment A. The following section highlights the key findings of the data validation for each analysis.

4.0 Analysis-Specific Data Validation Summaries

4.1 Volatile Organics by GC/MS SW846 8260B

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

The calibration of instruments is required to ensure that the instruments are operating properly. Calibration is achieved when instrument response can be related to the concentration of an analyte.

The following exhibited individual ICAL percent relative standard deviation > 30% and/or CCAL percent difference > 20%:

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
F93578	AP3088, AP3091, AP3092	Carbon tetrachloride	UJ
	AP3088	Chloromethane	
	AP3091, AP3092	Methylene chloride	

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met with the following exceptions:

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
F88782	AP3086	cis-1,3-Dichloropropene, Acetone, Bromoform, Styrene trans-1,3-Dichloropropene,	UJ

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Internal Standards
All internal standards met QC criteria.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.2 Semivolatile Organics by GC/MS SW846 8270C
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The calibration of instruments is required to ensure that the instruments are operating properly.

Calibration is achieved when instrument response can be related to the concentration of an analyte. All individual ICAL percent relative standard deviation > 30% and/or CCAL percent difference > 20% were found to be acceptable.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Internal Standards
All internal standards met QC criteria.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.3 Total and Dissolved Metals by SW846 6010B/7470A/7471

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Samples Affected	Analyte(s)	Validation Qualifier
F67482	AP0032, AP0033, AP0036, AP0037, AP0039, AP0040	(Total) Al, Sb, Ca, Mn, Ag, Zn	J/UJ

Laboratory Duplicate Sample Analysis
A Laboratory Duplicate Sample analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Interference Check Sample
All Interference Check Sample (ICS) percent recoveries were met with the following exceptions:

SDG Number	Samples Affected	Analyte(s)	Validation Qualifier
F88782	AP3086	Ba, Mg, Ca	J
F88900	AP3083, AP3084, AP3087	Ba, Mg, Ca, Fe	J/UJ

Inductively Coupled Plasma Serial Dilutions
All QC criteria were met for the serial dilutions associated with the project samples with the following exception(s):

SDG	Samples Affected	Analytes(s)	Validation Qualifier
F67482	AP0032, AP0033, AP0036, AP0037, AP0039, AP0040	(Total) Ca, Mn, Cr, Co, Fe, Mg, K	J

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as “B”, were qualified as estimated “J” unless blank contamination was present or the results were rejected.

4.4 Nitroaromatic and Nitroamine Explosives by SW846 8330A
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Second Column Confirmation
Samples having analytes with positive detects were verified on a second confirmation column; QC criteria (40% RPD) were met with the following exceptions:

SDG	Samples Affected	Analyte(s)	Validation Qualifier
F93578	AP3088	2-Nitrotoluene	J

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.5 Polychlorinated Biphenyls (PCBs) by SW846 8082
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified.

Second Column Confirmation
Samples having analytes with positive detects were verified on a second confirmation column; QC criteria (40% RPD) were met.

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.6 Wet Chemistry (TOC, Sulfate, Nitrate, Chloride, Alkalinity, Turbidity, TDS, TSS, Hardness, Cyanide

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Preservation
Preservation criteria were met for all samples.

Holding Times
Technical holding time criteria were met for all samples with the following exception(s):

SDG Number	Samples Affected	Analysis	Validation Qualifier
F88900	AP3083, AP3084, AP3087	Alkalinity, Carbonate	J

Initial and Continuing Calibration
All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks
The 5X rule for contaminants found in the associated equipment rinses and method blanks was applied to all sample results. All were found acceptable with the following exception(s):

Matrix Spike/Matrix Spike Duplicate
MS/MSD analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Samples Affected	Analytes(s)	Validation Qualifier
F88900	AP3083, AP3084	Sulfate	J

Laboratory Duplicate Sample Analysis
A Laboratory Duplicate Sample analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
LCS analysis was performed for the project samples, and all QC criteria were met.

Field Duplicates
Original and field duplicate results were evaluated and no problems were identified with the following exception(s):

SDG	Samples Affected	Compound(s)	Validation Qualifier
F88900	AP3083(original), AP3084(FD)	Total dissolved solids	J

Quantitation
Results quantified between the MDL and RL which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.0 Quality Assurance Field Split Sample Data Evaluation
Data from the quality assurance split samples, (SDGs: A9H220159 and 240-7113-1), were validated. The field split (FS) samples were analyzed for Volatiles by SW846 8260B, Semivolatiles by SW846 8270C, Explosives by SW846 8330, Polychlorinated Biphenyls (PCBs) by SW846 8280, Total and Dissolved Metals by SW 846 6010B and Wet Chemistry analyses. The following section highlights the key findings of the data validation for each analysis.

The following samples were validated for this site investigation:

SDG Number	Sample Number
240-7113-1	AP3085

5.1 Volatile Organics by GC/MS SW846 8260B

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks

The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries

All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample

Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Splits

A Relative Percent Difference is calculated for the analytes that were positive detects; the Regular/Field Duplicate/Field Split comparison of the data is listed in Table 2. The Original/Field Duplicate/Field Split samples that were analyzed for Volatiles are listed in the table below:

Sample/FD/FS
AP3083 (Original) / AP3084 (FD) / AP3085 (FS)

Internal Standards

All internal standards met QC criteria.

Quantitation

Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as “J”, were qualified as estimated “J” unless blank contamination was present or the results were rejected.

5.2 Semivolatile Organics by GC/MS SW846 8270C

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable, with the following exception(s):

SDG Number	Samples Affected	Analytes	Blank Contaminant	Validation Qualifier
240-7113-1	AP3085	Bis(2-ethylhexyl)phthalate	Method	B

Surrogate Recoveries
All surrogate recoveries were within QC limits, with the following exceptions:

SDG Number	Samples Affected	Analytes	Validation Qualifier
240-7113-1	AP3085	2-Nitrophenol, 4,6-Dinitro-2-methylphenol, 2,4-Dinitrophenol, 2,4-Dimethylphenol, 2,4,5-Trichlorophenol, 2-Methylphenol, 2,4,6-Trichlorophenol, Pentachlorophenol, 2,4-Dichlorophenol, Phenol, 2-Chlorophenol, 3-Methylphenol & 4-Methylphenol, 4-Nitrophenol, 4-Chloro-3-methylphenol	UJ

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Internal Standards
All internal standards met QC criteria.

Field Splits
A Relative Percent Difference is calculated for the analytes that were positive detects; the Regular/Field Duplicate/Field Split comparison of the data is listed in Table 2. The Original/Field Duplicate/Field Split samples that were analyzed for Semivolatiles are listed in the table below:

Sample/FD/FS
AP3083 (Original) / AP3084 (FD) / AP3085 (FS)

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.3 Total and Dissolved Metals by SW846 6010B/7470A/7471
Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Interference Check Sample
All Interference Check Sample (ICS) percent recoveries were acceptable. All QC criteria were met.

Inductively Coupled Plasma Serial Dilutions
All QC criteria were met for the serial dilutions associated with the project samples.

Field Splits
Table 2 shows the Regular/Field Duplicate/Field Split comparison of the data. A Relative Percent Difference is calculated for the analytes that were positive detects. The samples (Original/FD/FS) that had a metal analysis performed are listed below:

Sample/FD/FS
AP3083 (Original) / AP3084 (FD) / AP3085 (FS)

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "B", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.4 Nitroaromatic and Nitroamine Explosives by SW846 8330

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Field Splits
Original and field split results were evaluated and no problems were identified. All analytes were non-detect in the original and field split samples. Explosives by SW846 8330 analysis was performed on the original, field duplicate and field split samples listed below.

Sample/FD/FS
AP3083 (Original) / AP3084 (FD) / AP3085 (FS)

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.5 Polychlorinated Biphenyls (PCBs) by SW846 8082

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following;

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks
The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries
All surrogate recoveries were within QC limits.

Matrix Spike/Matrix Spike Duplicate
Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
Laboratory Control Sample (LCS) analysis was performed for the project samples and all QC criteria were met.

Second Column Confirmation
Samples having analytes with positive detects were verified on a second confirmation column; QC criteria (40% RPD) were met.

Field Splits
Original and field split results were evaluated and no problems were identified. All analytes were non-detect in the original and field split samples. A PCB analysis was performed on the original and field split samples listed below.

Sample/FD/FS
AP3083 (Original) / AP3084 (FD) / AP3085 (FS)

Quantitation
Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.6 Wet Chemistry (TOC, Sulfate, Nitrate, Chloride, Alkalinity, Turbidity, TDS, TSS, Hardness, Cyanide

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Preservation
Preservation criteria were met for all samples.

Holding Times
Technical holding time criteria were met for all samples.

Initial and Continuing Calibration
All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks
The 5X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable, with the following exception(s):

SDG Number	Samples Affected	Analytes	Blank Contaminant	Validation Qualifier
240-7113-1	AP3085	Nitrate-Nitrite	Method	B

Matrix Spike/Matrix Spike Duplicate
MS/MSD analysis was performed for the project samples, and all QC criteria were met.

Laboratory Duplicate Sample Analysis
A Laboratory Duplicate Sample analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample
LCS analysis was performed for the project samples, and all QC criteria were met.

Field Splits
Original and field split results were evaluated and no problems were identified. Wet Chemistry analyses were performed on the original, field duplicate and field split samples listed below.

Sample/FD/FS
AP3083 (Original) / AP3084 (FD) / AP3085 (FS)

Quantitation

Results quantified between the MDL and RL which the lab qualified as “J”, were qualified as estimated “J” unless blank contamination was present or the results were rejected.

Attachment A

Summary of Data Validation Reason Codes
Former Plum Brook Ordnance Works
Sandusky, Ohio

Reason Code	Description
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding Time Exceeded
02A	Extraction
02B	Analysis
03	Instrument Performance - Outside Criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	retention time windows
03E	Resolution
04	Initial Calibration results outside specified criteria
04A	Compound mean RRF<0.05
04B	Compound %RSD>30
04C	Correlation Coefficient<0.995
05	Continuing Calibration results outside specified criteria
05A	Compound mean RRF<0.05
05B	Compound %D>25
06	Result qualified as a result of the 5x/10x blank correction
06A	Method or Preparation Blank
06B	ICB or CCB
06C	ER
06D	TB
06E	FB
07	Surrogate Recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	%RPD outside acceptance criteria (precision)
09	Post Digestion Spike outside criteria (GFAA)
10	Internal Standards outside specified control limits
10A	Recovery
10B	Retention Time
11	Laboratory Control Sample recoveries outside specified control limits
11A	Recovery
11B	%RPD (if run in duplicate)
12	Interference Check Standard
13	Serial Dilution
14	Tentatively Identified Compounds
15	Quantitation
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria exceeded
18	Percent difference between original and second column > 25%
19	Professional judgement was used to qualify the data
20	Pesticide clean-up checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantitation
24	Reported result and/or lab qualifier revised to reflect validation findings
999	See hard copy for details.

Attachment A

Laboratory and Validation Qualifier Definitions
Former Plum Brook Ordnance Works
Sandusky, Ohio

Qualifier	Definition
Laboratory	
B (metals)	The analyte was detected; the concentration is below the reporting limit.
B (organics)	Indicates analyte is found in associated method blank.
J (metals)	The compound was detected in the blank.
J (organics)	The compound was positively identified; the reported value is below the reporting limit.
U	Not detected. The compound was analyzed for, but not detected above the associated reporting limit.
E	Indicates that the result is above the maximum calibration range.
N	Indicates presumptive evidence of a compound.
P	RPD > 40% between the primary and confirmation column results for dual column chromatographic method (e.g. GC and HPLC methods).
*	Exceeds QC limit.
Q1	The %D or %Drift for the associated CCV is outside the method QC limit.
ME	Marginal Exceedence of the 3-sigma QC limits.
ME*	Exceedence of the 4-sigma QC limits.
Validation	
B	The compound/analyte was detected in a lab or field blank.
J	The compound/analyte was positively identified; the reported value is an estimated concentration.
U	Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.
UJ	The analyte is not detected; the result is an estimated value.
R	Analyte is rejected.

Attachment A

Laboratory Control Limits for QC Samples
Plum Brook Ordnance Works

Spiked Compound	Accutest				Test America Laboratories, Inc.		
	Water - LCS	Water - MS/MSD			Water - LCS	Water - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)		% Recovery Range	% Recovery Range	Precision RPD (%)
Volatile Organic Compounds, SW846 8260B							
Acetone	59 - 134	59 - 134	14		N/A	N/A	N/A
Acrolein	N/A	N/A	N/A		N/A	N/A	N/A
Acrylonitrile	N/A	N/A	N/A		N/A	N/A	N/A
Benzene	83 - 124	83 - 124	11		78 - 118	78 - 118	N/A
Bromobenzene	N/A	N/A	N/A		N/A	N/A	N/A
Bromochloromethane	N/A	N/A	N/A		N/A	N/A	N/A
Bromodichloromethane	76 - 116	76 - 116	10		N/A	N/A	N/A
Bromomethane	N/A	N/A	N/A		N/A	N/A	N/A
Bromoform	68 - 128	68 - 128	11		N/A	N/A	N/A
2-Butanone	N/A	N/A	N/A		N/A	N/A	N/A
Chlorobenzene	87 - 115	87 - 115	9		76 - 117	76 - 117	N/A
Chloroethane	54 - 166	54 - 166	20		N/A	N/A	N/A
Chloromethane	N/A	N/A	N/A		N/A	N/A	N/A
Chloroform	85 - 123	85 - 123	10		N/A	N/A	N/A
2-Chlorotoluene	N/A	N/A	N/A		N/A	N/A	N/A
4-Chlorotoluene	N/A	N/A	N/A		N/A	N/A	N/A
Carbon disulfide	67 - 147	67 - 147	12		N/A	N/A	N/A
Carbon tetrachloride	74 - 139	74 - 139	13		N/A	N/A	N/A
1,2-Dibromoethane	N/A	N/A	N/A		N/A	N/A	N/A
1,1-Dichloroethane	82 - 127	82 - 127	10		N/A	N/A	N/A
1,1-Dichloroethylene	75 - 133	75 - 133	13		62 - 130	62 - 130	N/A
1,1-Dichloropropene	N/A	N/A	N/A		N/A	N/A	N/A
1,2-Dichloroethane	76 - 122	76 - 122	11		N/A	N/A	N/A
1,2-Dichloropropane	81 - 120	81 - 120	11		N/A	N/A	N/A
1,2-Dichlorobenzene	N/A	N/A	N/A		N/A	N/A	N/A
1,3-Dichlorobenzene	N/A	N/A	N/A		N/A	N/A	N/A
1,4-Dichlorobenzene	N/A	N/A	N/A		N/A	N/A	N/A
1,3-Dichloropropane	N/A	N/A	N/A		N/A	N/A	N/A
2,2-Dichloropropane	N/A	N/A	N/A		N/A	N/A	N/A
Dibromochloromethane	74 - 116	74 - 116	11		N/A	N/A	N/A
Dibromomethane	N/A	N/A	N/A		N/A	N/A	N/A
Dichlorodifluoromethane	N/A	N/A	N/A		N/A	N/A	N/A
1,2-Dibromo-3-chloropropane	N/A	N/A	N/A		N/A	N/A	N/A
cis-1,2-Dichloroethylene	81 - 114	81 - 114	10		N/A	N/A	N/A
cis-1,3-Dichloropropene	83 - 119	83 - 119	10		N/A	N/A	N/A
trans-1,2-Dichloroethylene	82 - 126	82 - 126	10		N/A	N/A	N/A
trans-1,3-Dichloropropene	87 - 123	87 - 123	10		N/A	N/A	N/A
Ethylbenzene	87 - 118	87 - 118	10		N/A	N/A	N/A
Hexachlorobutadiene	N/A	N/A	N/A		N/A	N/A	N/A
2-Hexanone	58 - 125	58 - 125	14		N/A	N/A	N/A
Isopropylbenzene	N/A	N/A	N/A		N/A	N/A	N/A
4-Isopropyltoluene	N/A	N/A	N/A		N/A	N/A	N/A
4-Methyl-2-pentanone	62 - 125	62 - 125	13		N/A	N/A	N/A
Methyl bromide	55 - 151	55 - 151	21		N/A	N/A	N/A
Methyl chloride	55 - 173	55 - 173	22		N/A	N/A	N/A
Methylene chloride	69 - 125	69 - 125	11		N/A	N/A	N/A
Methyl ethyl ketone	61 - 127	61 - 127	13		N/A	N/A	N/A
Methyl tert-Butyl Ether	N/A	N/A	N/A		N/A	N/A	N/A

Attachment A

Laboratory Control Limits for QC Samples
Plum Brook Ordnance Works

Spiked Compound	Accutest				Test America Laboratories, Inc.		
	Water - LCS	Water - MS/MSD			Water - LCS	Water - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)		% Recovery Range	% Recovery Range	Precision RPD (%)
n-Butylbenzene	N/A	N/A	N/A		N/A	N/A	N/A
Naphthalene	N/A	N/A	N/A		N/A	N/A	N/A
n- Propylbenzene	N/A	N/A	N/A		N/A	N/A	N/A
sec-Butylbenzene	N/A	N/A	N/A		N/A	N/A	N/A
Styrene	78 - 118	78 - 118	11		N/A	N/A	N/A
1,1,1-Trichloroethane	79 - 133	79 - 133	11		N/A	N/A	N/A
1,1.1,2-Tetrachloroethane	N/A	N/A	N/A		N/A	N/A	N/A
1,1,2,2-Tetrachloroethane	71 - 120	71 - 120	11		N/A	N/A	N/A
1,1,2-Trichloroethane	80 - 114	80 - 114	11		N/A	N/A	N/A
1,2,3-Trichlorobenzene	N/A	N/A	N/A		N/A	N/A	N/A
1,2,3-Trichloropropane	N/A	N/A	N/A		N/A	N/A	N/A
1,3,5-Trimethylbenzene	N/A	N/A	N/A		N/A	N/A	N/A
1,2,4-Trichlorobenzene	N/A	N/A	N/A		N/A	N/A	N/A
1,2,4-Trimethylbenzene	N/A	N/A	N/A		N/A	N/A	N/A
Tetrachloroethylene	80 - 131	80 - 131	12		N/A	N/A	N/A
tert-Butylbenzene	N/A	N/A	N/A		N/A	N/A	N/A
Toluene	86 - 116	86 - 116	10		70 - 119	70 - 119	N/A
Trichloroethylene	85 - 124	85 - 124	10		62 - 130	62 - 130	N/A
Trichlorofluoromethane	N/A	N/A	N/A		N/A	N/A	N/A
Vinyl chloride	57 - 153	57 - 153	22		N/A	N/A	N/A
Vinyl acetate	N/A	N/A	N/A		N/A	N/A	N/A
m-Xylene/p-Xylene	N/A	N/A	N/A		N/A	N/A	N/A
o-Xylene	N/A	N/A	N/A		N/A	N/A	N/A
Xylene (total)	86 - 120	86 - 120	10		N/A	N/A	N/A
Surrogates							
Dibromofluoromethane	87 - 116	87 - 116	N/A		85-115	85-115	N/A
1,2-Dichloroethane-D4	76 - 127	76 - 127	N/A		70-120	70-120	N/A
Toluene-D8	86 - 112	86 - 112	N/A		85-120	85-120	N/A
4-Bromofluorobenzene	84 - 120	84 - 120	N/A		75-120	75-120	N/A
Semivolatile Organic Compounds, SW-846 8270C							
Benzoic Acid	10 - 50	10 - 50	40		N/A	N/A	N/A
2-Chlorophenol	44 - 103	44 - 103	29		27 - 110	27 - 110	30
4-Chloro-3-methyl phenol	53 - 105	53 - 105	24		39 - 110	39 - 110	30
2,4-Dichlorophenol	53 - 108	53 - 108	26		N/A	N/A	N/A
2,4-Dimethylphenol	37 - 91	37 - 91	28		N/A	N/A	N/A
2,4-Dinitrophenol	37 - 111	37 - 111	30		N/A	N/A	N/A
4,6-Dinitro-o-cresol	62 - 115	62 - 115	26		N/A	N/A	N/A
2-Methylphenol	35 - 91	35 - 91	30		N/A	N/A	N/A
4-Methylphenol	N/A	N/A	N/A		N/A	N/A	N/A
3&4-Methylphenol	32 - 85	32 - 85	29		N/A	N/A	N/A
2-Nitrophenol	49 - 111	49 - 111	30		N/A	N/A	N/A
4-Nitrophenol	13 - 55	13 - 55	31		12 - 130	12 - 130	30
Pentachlorophenol	57 118	57 118	26		26 - 110	26 - 110	30
Phenol	13 - 54	13 - 54	34		14 - 112	14 - 112	30
2,4,5-Trichlorophenol	59 - 106	59 - 106	23		N/A	N/A	N/A
2,4,6-Trichlorophenol	58 - 107	58 - 107	24		N/A	N/A	N/A
Acenaphthene	58 - 106	58 - 106	21		40 - 110	40 - 110	30
Acenaphthylene	58 - 105	58 - 105	21		N/A	N/A	N/A
Anthracene	65 - 108	65 - 108	19		N/A	N/A	N/A

Attachment A

Laboratory Control Limits for QC Samples
Plum Brook Ordnance Works

Spiked Compound	Accutest				Test America Laboratories, Inc.		
	Water - LCS	Water - MS/MSD			Water - LCS	Water - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)		% Recovery Range	% Recovery Range	Precision RPD (%)
Benzo(a)anthracene	63 - 111	63 - 111	19		N/A	N/A	N/A
Benzo(a)pyrene	62 - 106	62 - 106	20		N/A	N/A	N/A
Benzo(b)fluoranthene	63 - 109	63 - 109	20		N/A	N/A	N/A
Benzo(g,h,i)perylene	61 - 111	61 - 111	21		N/A	N/A	N/A
Benzo(k)fluoranthene	64 - 111	64 - 111	20		N/A	N/A	N/A
4-Bromophenol phenyl ether	64 - 107	64 - 107	20		N/A	N/A	N/A
Butyl benzyl phthalate	59 - 114	59 - 114	20		N/A	N/A	N/A
Benzyl Alcohol	34 - 98	34 - 98	27		N/A	N/A	N/A
2-Chloronaphthalene	54 - 105	54 - 105	24		N/A	N/A	N/A
4-Chloroaniline	53 - 103	53 - 103	22		N/A	N/A	N/A
Carbazole	66 - 109	66 - 109	20		N/A	N/A	N/A
Chrysene	64 - 111	64 - 111	19		N/A	N/A	N/A
bis(2-Chloroethyoxy)methane	48 - 101	48 - 101	28		N/A	N/A	N/A
bis(2-Chloroethyl)ether	51 - 108	51 - 108	27		N/A	N/A	N/A
bis(2-Chloroisopropyl)ether	43 - 106	43 - 106	27		N/A	N/A	N/A
4-Chlorophenyl pheny ether	61 - 107	61 - 107	20		N/A	N/A	N/A
1,2-Dichlorobenzene	41 - 102	41 - 102	28		N/A	N/A	N/A
1,3-Dichlorobenzene	38 - 100	38 - 100	28		N/A	N/A	N/A
1,4-Dichlorobenzene	40 - 100	40 - 100	28		19 - 110	19 - 110	30
2,4-Dinitrotoluene	60 - 109	60 - 109	20		52 - 123	52 - 123	30
2,6-Dinitrotoluene	58 - 104	58 - 104	21		N/A	N/A	N/A
3,3'-Dichlorobenzidine	57 - 105	57 - 105	25		N/A	N/A	N/A
Dibenzo(a,h)antracene	62 - 112	62 - 112	20		N/A	N/A	N/A
Dibenzofuran	61 - 108	61 - 108	20		N/A	N/A	N/A
Di-n-butyl phthalate	62 - 109	62 - 109	20		N/A	N/A	N/A
Di-n-octyl phthalate	60 - 120	60 - 120	24		N/A	N/A	N/A
Diethyl phthalate	62 - 109	62 - 109	19		N/A	N/A	N/A
Dimethyl phthalate	63 - 106	63 - 106	19		N/A	N/A	N/A
Diphenylamine	N/A	N/A	N/A		N/A	N/A	N/A
bis(2-Ethylhexyl)phthalate	59 - 116	59 - 116	21		N/A	N/A	N/A
Fluoranthene	65 - 114	65 - 114	21		N/A	N/A	N/A
Fluorene	61 - 106	61 - 106	19		N/A	N/A	N/A
Hexachlorobenzene	62 - 107	62 - 107	20		N/A	N/A	N/A
Hexachlorobutadiene	38 - 107	38 - 107	30		N/A	N/A	N/A
Hexachlorocyclopentadiene	19 - 84	19 - 84	35		N/A	N/A	N/A
Hexachloroethane	35 - 101	30 - 101	29		N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	61 - 113	61 - 113	20		N/A	N/A	N/A
Isophorone	56 - 111	56 - 111	26		N/A	N/A	N/A
2-Metlhyl-4,6-dinitrophenol	N/A	N/A	N/A		N/A	N/A	N/A
2-Methylnaphthalene	56 - 112	56 - 112	26		N/A	N/A	N/A
2-Nitroaniline	60 - 109	60 - 109	20		N/A	N/A	N/A
3-Nitroaniline	52 - 107	52 - 107	21		N/A	N/A	N/A
4-Nitroaniline	59 - 111	59 - 111	21		N/A	N/A	N/A
Naphthalene	50 - 104	50 - 104	28		N/A	N/A	N/A
Nitrobenzene	52 - 105	52 - 105	28		N/A	N/A	N/A
N-Nitroso-di-n-propylamine	51 - 104	51 - 104	28		37 - 121	37 - 121	30
N-Nitrosodimethylamine	N/A	N/A	N/A		N/A	N/A	N/A
N-Nitrosodiphenylamine	57 - 110	57 - 110	19		N/A	N/A	N/A
Phenanthrene	65 - 108	65 - 108	20		N/A	N/A	N/A

Attachment A

Laboratory Control Limits for QC Samples
Plum Brook Ordnance Works

Spiked Compound	Accutest				Test America Laboratories, Inc.		
	Water - LCS	Water - MS/MSD			Water - LCS	Water - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)		% Recovery Range	% Recovery Range	Precision RPD (%)
Pyrene	60 - 113	60 - 113	20		55 - 120	55 - 120	30
1,2,4-Trichlorobenzene	45 - 104	45 - 104	28		25 - 110	25 - 110	30
Surrogates							
2-Fluorophenol	14 - 62	14 - 62	N/A		20-110	20-110	N/A
Phenol-d5	10 - 40	10 - 40	N/A		10-115	10-115	N/A
2,4,6-Tribromophenol	33 - 118	33 - 118	N/A		40-125	40-125	N/A
Nitrobenzene-d5	42 - 108	42 - 108	N/A		40-110	40-110	N/A
2-Fluorobiphenyl	40 - 106	40 - 106	N/A		50-110	50-110	N/A
Terphenyl-d14	39 - 121	39 - 121	N/A		50-135	50-135	N/A
Nitroaromatics and Nitroamines, SW-846 8330							
HMX	74 - 152	74 - 152	21		80 - 115	80 - 115	30
RDX	80 - 124	80 - 124	20		50 - 160	50 - 160	30
1,3-Dinitrobenzene	84 - 123	84 - 123	23		45 - 160	45 - 160	30
2,6-Dinitrotoluene	84 - 133	84 - 133	23		60 - 135	60 - 135	30
2,4-Dinitrotoluene	77 - 116	77 - 116	26		60 - 135	60 - 135	30
2-amino-4,6-Dinitrotoluene	78 - 117	78 - 117	28		55 - 155	55 - 155	30
4-amino-2,6-Dinitrotoluene	84 - 123	84 - 123	27		55 - 155	55 - 155	30
Nitrobenzene	76 - 128	76 - 128	28		50 - 140	50 - 140	30
o-Nitrotoluene	76 - 120	76 - 120	30		50 - 130	50 - 130	30
m-Nitrotoluene	74 - 124	74 - 124	32		45 - 135	45 - 135	30
p-Nitrotoluene	81 - 125	81 - 125	34		50 - 130	50 - 130	30
Tetryl	62 - 117	62 - 117	28		20 - 175	20 - 175	30
1,3,5-Trinitrobenzene	85 - 127	85 - 127	21		65 - 140	65 - 140	30
2,4,6-Trinitrotoluene	71 - 128	71 - 128	21		50 - 145	50 - 145	30
Nitroglycerin	N/A	N/A	N/A		76 - 116	76 - 116	30
PETN	N/A	N/A	N/A		69 - 117	69 - 117	30
Surrogates							
3,4-Dinitrotoluene	70 - 136	70 - 136	N/A		79-111	79-111	N/A
PCBs, SW-846 8082							
Aroclor-1016	76 - 117	76 - 117	16		44 - 119	10 - 199	30
Aroclor-1260	65 - 117	65 - 117	23		41 - 118	10 - 199	30
Surrogates							
Tetrachloro-m-xylene	38 - 127	38 - 127	N/A		27-130	27-130	N/A
Decachlorobiphenyl	25 - 137	25 - 137	N/A		10-127	10-127	N/A
Metals, SW-846 6010B/6020A/7470A							
Aluminum	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Antimony	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Arsenic	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Barium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Beryllium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Cadmium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Calcium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Chromium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Cobalt	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Copper	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Iron	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Lead	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Magnesium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Manganese	80 - 120	80 - 120	20		80 - 120	75 - 125	20

Attachment A

Laboratory Control Limits for QC Samples
Plum Brook Ordnance Works

Spiked Compound	Accutest				Test America Laboratories, Inc.		
	Water - LCS	Water - MS/MSD			Water - LCS	Water - MS/MSD	
	% Recovery Range	% Recovery Range	Precision RPD (%)		% Recovery Range	% Recovery Range	Precision RPD (%)
Nickel	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Potassium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Selenium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Silver	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Sodium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Thallium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Vanadium	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Zinc	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Mercury	80 - 120	80 - 120	20		80 - 120	75 - 125	20
Water Quality							
Chloride	90 - 110	90 - 110	20		90 - 110	80 - 120	20
Hardness as CaCO3	N/A	N/A	N/A		88 - 110	87 - 114	20
Nitrate	90 - 110	90 - 110	20		90 - 110	34 - 125	20
Sulfate	90 - 110	90 - 110	20		90 - 110	80 - 120	20
Total Alkalinity	90 - 113	90 - 113	20		90 - 127	10 - 160	24
Total Cyanide	90 - 110	90 - 110	20		69 - 118	42 - 140	20
Total Dissolved Solids	N/A	N/A	5		88 - 110	N/A	20
Total Suspended Solids	N/A	N/A	5		73 - 113	N/A	20
Turbidity	N/A	N/A	8		75 - 125	N/A	20

LCS - Laboratory Control Sample
MS/MSD - Matrix Spike/Matrix Spike Duplicate
RPD - Relative Percent Difference
N/A - Not Applicable

APPENDIX G

CHEMICAL ANALYTICAL DATA SUMMARY

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Location:		CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB02			CY3-SB02			CY3-SB02		
Sample Number:		CY0031			CY0032			CY0033			CY0034			CY0035			CY0036			CY0037			CY0038		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		0.2 - 1.2 Ft			3 - 5 Ft			3 - 5 Ft			3 - 5 Ft			8 - 10 Ft			1.5 - 2.5 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			FD			FS			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Explosives																									
Amino-2,6-dinitrotoluene, 4-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Amino-4,6-dinitrotoluene, 2-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Dinitrobenzene, 1,3-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Dinitrotoluene, 2,4-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Dinitrotoluene, 2,6-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
HMX	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Nitrobenzene	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Nitrotoluene, 2-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Nitrotoluene, 3-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Nitrotoluene, 4-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
RDX	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Tetryl	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Trinitrobenzene, 1,3,5-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Trinitrotoluene, 2,4,6-	mg/kg	0.14	U	U	0.18	U	U	0.16	U	U	0.098	U	U	0.16	U	U	0.15	U	U	0.18	U	U	0.16	U	U
Semivolatiles																									
3-Methylphenol and 4-Methylph	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.49	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Acenaphthene	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Acenaphthylene	mg/kg	0.0657	J	J	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.0619	J	J	0.2	U	U	0.22	U	U
ACETOPHENONE	mg/kg	-	-	-	-	-	-	-	-	-	0.12	U	U	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	0.171	J	J	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.0738	J	J	0.2	U	U	0.22	U	U
Atrazine	mg/kg	-	-	-	-	-	-	-	-	-	0.24	U	U	-	-	-	-	-	-	-	-	-	-	-	-
Benzaldehyde	mg/kg	-	-	-	-	-	-	-	-	-	0.12	U	U	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.407			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.348			0.2	U	U	0.22	U	U
Benzo(a)pyrene	mg/kg	0.326			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.403			0.2	U	U	0.22	U	U
Benzo(b)fluoranthene	mg/kg	0.414			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.582			0.2	U	U	0.22	U	U
Benzo(ghi)perylene	mg/kg	0.203			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.277			0.2	U	U	0.22	U	U
Benzo(k)fluoranthene	mg/kg	0.163	J	J	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.188	J	J	0.2	U	U	0.22	U	U
Benzoic acid	mg/kg	0.97	U	U	1	U	U	1	U	U	-	-	-	1	U	U	1	U	U	1	U	U	1.1	U	U
Benzyl alcohol	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	-	-	-	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
BIBENZENE	mg/kg	0			-	-	-	-	-	-	0.061	U	U	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.12	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Bis(2-chloroethyl)ether	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.12	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Bis(2-chloroisopropyl)ether	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.12	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Bis(2-ethylhexyl)phthalate	mg/kg	0.39	U	U	0.41	U	U	0.41	U	U	0.061	U	U	0.41	U	U	0.4	U	U	0.4	U	U	0.44	U	U
Bromophenyl phenyl ether, 4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Butyl benzyl phthalate	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Caprolactam	mg/kg	0			-	-	-	-	-	-	0.4	U	U	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Location:		CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB02			CY3-SB02			CY3-SB02		
Sample Number:		CY0031			CY0032			CY0033			CY0034			CY0035			CY0036			CY0037			CY0038		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		0.2 - 1.2 Ft			3 - 5 Ft			3 - 5 Ft			3 - 5 Ft			8 - 10 Ft			1.5 - 2.5 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			FD			FS			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Carbazole	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chloro-3-methylphenol, 4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.18	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chloroaniline, 4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.18	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chloronaphthalene, 2-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chlorophenol, 2-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chlorophenyl phenyl ether, 4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chrysene	mg/kg	0.387			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.443			0.2	U	U	0.22	U	U
Dibenz(a,h)anthracene	mg/kg	0.0416	J	J	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.0589	J	J	0.2	U	U	0.22	U	U
Dibenzofuran	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzene, 1,2-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	-	-	-	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzene, 1,3-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	-	-	-	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzene, 1,4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	-	-	-	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzidine, 3,3'-	mg/kg	0.39	U	U	0.41	U	U	0.41	U	U	0.12	U	U	0.41	U	U	0.4	U	U	0.4	U	U	0.44	U	U
Dichlorophenol, 2,4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.18	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Diethyl phthalate	mg/kg	0.39	U	U	0.41	U	U	0.41	U	U	0.061	U	U	0.41	U	U	0.4	U	U	0.4	U	U	0.44	U	U
Dimethyl phthalate	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dimethylphenol, 2,4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.18	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Di-n-butyl phthalate	mg/kg	0.39	U	U	0.41	U	U	0.41	U	U	0.061	U	U	0.41	U	U	0.4	U	U	0.4	U	U	0.44	U	U
Dinitro-2-methylphenol, 4,6-	mg/kg	0.39	U	U	0.41	U	U	0.41	U	U	0.18	U	U	0.41	U	U	0.4	U	U	0.4	U	U	0.44	U	U
Dinitrophenol, 2,4-	mg/kg	0.97	U	U	1	U	U	1	U	U	0.4	U	U	1	U	U	1	U	U	1	U	U	1.1	U	U
Dinitrotoluene, 2,4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.24	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dinitrotoluene, 2,6-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.24	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Di-n-octyl phthalate	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Fluoranthene	mg/kg	0.843			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.662			0.2	U	U	0.22	U	U
Fluorene	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachlorobenzene	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachlorobutadiene	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachlorocyclopentadiene	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.4	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachloroethane	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Indeno(1,2,3-cd)pyrene	mg/kg	0.223			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.294			0.2	U	U	0.22	U	U
Isophorone	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Methylnaphthalene, 2-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.01			0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Methylphenol, 2-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.24	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Naphthalene	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitroaniline, 2-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.24	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitroaniline, 3-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.24	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitroaniline, 4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.24	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitrobenzene	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.12	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Location:		CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB02			CY3-SB02			CY3-SB02		
Sample Number:		CY0031			CY0032			CY0033			CY0034			CY0035			CY0036			CY0037			CY0038		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		0.2 - 1.2 Ft			3 - 5 Ft			3 - 5 Ft			3 - 5 Ft			8 - 10 Ft			1.5 - 2.5 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			FD			FS			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Nitrophenol, 2-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitrophenol, 4-	mg/kg	0.97	U	U	1	U	U	1	U	U	0.4	U	U	1	U	U	1	U	U	1	U	U	1.1	U	U
n-Nitroso-di-n-propylamine	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
n-Nitrosodiphenylamine	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Pentachlorophenol	mg/kg	0.97	U	U	1	U	U	1	U	U	0.18	U	U	1	U	U	1	U	U	1	U	U	1.1	U	U
Phenanthrene	mg/kg	0.415			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.249			0.2	U	U	0.22	U	U
Phenol	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.061	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Pyrene	mg/kg	0.636			0.21	U	U	0.21	U	U	0.0081	U	U	0.2	U	U	0.508			0.2	U	U	0.22	U	U
Trichlorobenzene, 1,2,4-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	-	-	-	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Trichlorophenol, 2,4,5-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.18	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Trichlorophenol, 2,4,6-	mg/kg	0.19	U	U	0.21	U	U	0.21	U	U	0.18	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Pesticides/PCBs																									
Aroclor 1016	mg/kg	0.02	U	U	0.02	U	U	0.02	U	U	0.08	U	U	-	-	-	0.02	U	U	0.02	U	U	-	-	-
Aroclor 1221	mg/kg	0.02	U	U	0.02	U	U	0.02	U	U	0.061	U	U	-	-	-	0.02	U	U	0.02	U	U	-	-	-
Aroclor 1232	mg/kg	0.02	U	U	0.02	U	U	0.02	U	U	0.055	U	U	-	-	-	0.02	U	U	0.02	U	U	-	-	-
Aroclor 1242	mg/kg	0.02	U	U	0.02	U	U	0.02	U	U	0.049	U	U	-	-	-	0.02	U	U	0.02	U	U	-	-	-
Aroclor 1248	mg/kg	0.02	U	U	0.02	U	U	0.02	U	U	0.067	U	U	-	-	-	0.02	U	U	0.02	U	U	-	-	-
Aroclor 1254	mg/kg	0.02	U	U	0.02	U	U	0.02	U	U	0.067	U	U	-	-	-	0.02	U	U	0.02	U	U	-	-	-
Aroclor 1260	mg/kg	0.02	U	U	0.02	U	U	0.02	U	U	0.067	U	U	-	-	-	0.02	U	U	0.02	U	U	-	-	-
Metals - Unfiltered																									
Aluminum	mg/kg	7110			11400			11400			8700			6040			4130			8230			6530		
Antimony	mg/kg	1.8	U	U	4.8	U	U	6.2	U	U	3.4	U	UJ	1.9	U	U	3.9	U	U	1.9	U	U	0.15	B	J
Arsenic	mg/kg	8.8			8.7			12.9			4.2			8.6			3.6			7.5			5.6		
Barium	mg/kg	44.7			64.3			70.7			61			53.2			19.3			58.2			50.2		
Beryllium	mg/kg	0.42	B	J	0.7	B	J	0.61	B	J	0.18	J	J	0.3			0.19	B	J	0.49			0.38		
Cadmium	mg/kg	0.16	B	J	0.96	U	U	1.2	U	U	0.054	J	J	0.11	B	J	0.79	U	U	0.38	U	U	0.42		
Calcium	mg/kg	20200			2740			3260			2700		J	40300			68000			2340			14000		
Chromium	mg/kg	9.6			15.6			17.2			12		J	10.7			6.7			12.1			9.4		
Cobalt	mg/kg	8.1			8.6	B	J	8.4	B	J	6			5.5			2.7			5.9			6.1		
Copper	mg/kg	15.2			13.2			19.5			9.2		J	14.3			7.4			12.2			13		
Iron	mg/kg	14500			18700			25800			14000			11600			6480			15000			12100		
Lead	mg/kg	11			8.6			9.7			5.7			9.7			5.8			9.3			9.7		
Magnesium	mg/kg	5920			2250			1970			2000	B		12000			5020			1600			6010		
Manganese	mg/kg	316			426			291			230		J	274			240			251			269		
Mercury	mg/kg	0.029	B	J	0.021	B	J	0.049	B	J	0.022	J	J	0.013	B	J	0.03	B	J	0.033	B	J	0.022	B	J
Nickel	mg/kg	19.8			19.6			23.9			13			14.8			5.8			15.6			14.6		
Potassium	mg/kg	755	B	J	697	B	J	598	B	J	550	J	J	982			273	B	J	478	B	J	465	B	J
Selenium	mg/kg	1.8	U	U	4.8	U	U	6.2	U	U	2.2	U	U	1.9	U	U	3.9	U	U	1.9	U	U	1	U	U

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Location:		CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB02			CY3-SB02			CY3-SB02		
Sample Number:		CY0031			CY0032			CY0033			CY0034			CY0035			CY0036			CY0037			CY0038		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		0.2 - 1.2 Ft			3 - 5 Ft			3 - 5 Ft			3 - 5 Ft			8 - 10 Ft			1.5 - 2.5 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			FD			FS			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Silver	mg/kg	0.88	U	U	2.4	U	U	3.1	U	U	0.56	U	U	0.46	U	U	0.39	U	U	0.94	U	U	0.5	U	U
Sodium	mg/kg	880	U	U	2400	U	U	3100	U	U	560	U	U	91.5	B	J	57	B	J	940	U	U	55.7	B	J
Thallium	mg/kg	0.44	U	U	0.48	U	U	0.62	U	U	1	J	J	0.93	U	U	2	U	U	0.47	U	U	0.5	U	U
Vanadium	mg/kg	16.2			27.3			33.4			19			12.2			10.7			23.7			16.2		
Zinc	mg/kg	48.9			38.5			50.4			30		J	38.3			14.6			30.9			29		
General Chemistry																									
% Solids	Percent	85.1			81			80.1			-	-	-	80.5			83			81.7			77.1		
Total organic carbon	Percent	0.66			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

	Location:	CY3-SB03			CY3-SB03			CY3-SB03			CY3-SB04			CY3-SB04			CY3-SB04		
	Sample Number:	CY0039			CY0040			CY0041			CY0042			CY0043			CY0044		
	Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
	Sample Depth:	0 - 1 Ft			3 - 5 Ft			8 - 10 Ft			0 - 1 Ft			3 - 5 Ft			8 - 10 Ft		
	Sample Purpose:	REG			REG			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Explosives																			
Amino-2,6-dinitrotoluene, 4-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Amino-4,6-dinitrotoluene, 2-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Dinitrobenzene, 1,3-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Dinitrotoluene, 2,4-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Dinitrotoluene, 2,6-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
HMX	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Nitrobenzene	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Nitrotoluene, 2-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Nitrotoluene, 3-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Nitrotoluene, 4-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
RDX	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Tetryl	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Trinitrobenzene, 1,3,5-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Trinitrotoluene, 2,4,6-	mg/kg	0.18	U	U	0.17	U	U	0.14	U	U	0.15	U	U	0.16	U	U	0.16	U	U
Semivolatiles																			
3-Methylphenol and 4-Methylph	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Acenaphthene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Acenaphthylene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
ACETOPHENONE	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Atrazine	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzaldehyde	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.0366	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Benzo(a)pyrene	mg/kg	0.032	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Benzo(b)fluoranthene	mg/kg	0.0291	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Benzo(ghi)perylene	mg/kg	0.0224	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Benzo(k)fluoranthene	mg/kg	0.0269	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Benzoic acid	mg/kg	0.98	U	U	1	U	UJ	1	U	U	0.98	U	U	1	U	U	1.1	U	U
Benzyl alcohol	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
BIBENZENE	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Bis(2-chloroethyl)ether	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Bis(2-chloroisopropyl)ether	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Bis(2-ethylhexyl)phthalate	mg/kg	0.39	U	U	0.4	U	U	0.42	U	U	0.39	U	U	0.41	U	U	0.44	U	U
Bromophenyl phenyl ether, 4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Butyl benzyl phthalate	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Caprolactam	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Location:		CY3-SB03			CY3-SB03			CY3-SB03			CY3-SB04			CY3-SB04			CY3-SB04		
Sample Number:		CY0039			CY0040			CY0041			CY0042			CY0043			CY0044		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		0 - 1 Ft			3 - 5 Ft			8 - 10 Ft			0 - 1 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Carbazole	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chloro-3-methylphenol, 4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chloroaniline, 4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chloronaphthalene, 2-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chlorophenol, 2-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chlorophenyl phenyl ether, 4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Chrysene	mg/kg	0.0406	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dibenz(a,h)anthracene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dibenzofuran	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzene, 1,2-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzene, 1,3-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzene, 1,4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dichlorobenzidine, 3,3'-	mg/kg	0.39	U	U	0.4	U	U	0.42	U	U	0.39	U	U	0.41	U	U	0.44	U	U
Dichlorophenol, 2,4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Diethyl phthalate	mg/kg	0.39	U	U	0.4	U	U	0.42	U	U	0.39	U	U	0.41	U	U	0.44	U	U
Dimethyl phthalate	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dimethylphenol, 2,4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Di-n-butyl phthalate	mg/kg	0.39	U	U	0.4	U	U	0.42	U	U	0.39	U	U	0.41	U	U	0.44	U	U
Dinitro-2-methylphenol, 4,6-	mg/kg	0.39	U	U	0.4	U	U	0.42	U	U	0.39	U	U	0.41	U	U	0.44	U	U
Dinitrophenol, 2,4-	mg/kg	0.98	U	U	1	U	U	1	U	U	0.98	U	U	1	U	U	1.1	U	U
Dinitrotoluene, 2,4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Dinitrotoluene, 2,6-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Di-n-octyl phthalate	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Fluoranthene	mg/kg	0.0525	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Fluorene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachlorobenzene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachlorobutadiene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachlorocyclopentadiene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Hexachloroethane	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Indeno(1,2,3-cd)pyrene	mg/kg	0.0255	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Isophorone	mg/kg	0.2	U	U	0.2	U	UJ	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Methylnaphthalene, 2-	mg/kg	0.021	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Methylphenol, 2-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Naphthalene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitroaniline, 2-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitroaniline, 3-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitroaniline, 4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitrobenzene	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Location:		CY3-SB03			CY3-SB03			CY3-SB03			CY3-SB04			CY3-SB04			CY3-SB04		
Sample Number:		CY0039			CY0040			CY0041			CY0042			CY0043			CY0044		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		0 - 1 Ft			3 - 5 Ft			8 - 10 Ft			0 - 1 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Nitrophenol, 2-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Nitrophenol, 4-	mg/kg	0.98	U	U	1	U	U	1	U	U	0.98	U	U	1	U	U	1.1	U	U
n-Nitroso-di-n-propylamine	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
n-Nitrosodiphenylamine	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Pentachlorophenol	mg/kg	0.98	U	U	1	U	U	1	U	U	0.98	U	U	1	U	U	1.1	U	U
Phenanthrene	mg/kg	0.0278	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Phenol	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Pyrene	mg/kg	0.0438	J	J	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Trichlorobenzene, 1,2,4-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Trichlorophenol, 2,4,5-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Trichlorophenol, 2,4,6-	mg/kg	0.2	U	U	0.2	U	U	0.21	U	U	0.2	U	U	0.2	U	U	0.22	U	U
Pesticides/PCBs																			
Aroclor 1016	mg/kg	0.019	U	U	0.02	U	U	-	-	-	0.019	U	U	0.021	U	U	-	-	-
Aroclor 1221	mg/kg	0.019	U	U	0.02	U	U	-	-	-	0.019	U	U	0.021	U	U	-	-	-
Aroclor 1232	mg/kg	0.019	U	U	0.02	U	U	-	-	-	0.019	U	U	0.021	U	U	-	-	-
Aroclor 1242	mg/kg	0.019	U	U	0.02	U	U	-	-	-	0.019	U	U	0.021	U	U	-	-	-
Aroclor 1248	mg/kg	0.019	U	U	0.02	U	U	-	-	-	0.019	U	U	0.021	U	U	-	-	-
Aroclor 1254	mg/kg	0.019	U	U	0.02	U	U	-	-	-	0.019	U	U	0.021	U	U	-	-	-
Aroclor 1260	mg/kg	0.019	U	U	0.02	U	U	-	-	-	0.019	U	U	0.021	U	U	-	-	-
Metals - Unfiltered																			
Aluminum	mg/kg	5780			7270		J	7100			4640			8390			7330		
Antimony	mg/kg	1.9	U	U	1.1	U	UJ	0.29	B	J	1.5	U	U	2.4	U	U	2.1	U	U
Arsenic	mg/kg	7.2			3.7		J	4.8			4.9			7.8			7.3		
Barium	mg/kg	37.4			51		J	46.1			42.4			66.3			59.6		
Beryllium	mg/kg	0.3			0.38		J	0.37			0.25			0.49	B	J	0.38		
Cadmium	mg/kg	0.18	B	J	0.26		J	0.61			0.14	B	J	0.47	U	U	0.21	B	J
Calcium	mg/kg	38500			2850		J	28500			31800			2860			42700		
Chromium	mg/kg	10.3			9.1		J	10.4			8.6			12.6			14.3		
Cobalt	mg/kg	6.7			3.6		J	6.2			4.7			6.7			9		
Copper	mg/kg	14.7			10.5		J	16.1			12			15.7			18.9		
Iron	mg/kg	12100			9520		J	13600			8830			16400			13900		
Lead	mg/kg	10			9.4		J	10			9.9			9.4			12.8		
Magnesium	mg/kg	10900			1450		J	9740			9390			1990			12900		
Manganese	mg/kg	325			158		J	346			236			436			400		
Mercury	mg/kg	0.018	B	J	0.05	B	J	0.019	B	J	0.02	B	J	0.034	B	J	0.015	B	J
Nickel	mg/kg	17.5			8.8		J	17.3			12			18.7			21.6		
Potassium	mg/kg	921			387	B	J	929			558			454	B	J	1010		
Selenium	mg/kg	1.9	U	U	1.1	U	UJ	1.1	U	U	1.5	U	U	2.4	U	U	2.1	U	U

Appendix G

Coal Yard 3 Chemical Analytical Data Summary
Ash Pit 1 and Ash Pit 3 SCR Addendum for Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio

Location:		CY3-SB03			CY3-SB03			CY3-SB03			CY3-SB04			CY3-SB04			CY3-SB04		
Sample Number:		CY0039			CY0040			CY0041			CY0042			CY0043			CY0044		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		0 - 1 Ft			3 - 5 Ft			8 - 10 Ft			0 - 1 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Silver	mg/kg	0.48	U	U	0.56	U	UJ	0.54	U	U	0.37	U	U	1.2	U	U	0.53	U	U
Sodium	mg/kg	92.1	B	J	560	U	UJ	76.9	B	J	70	B	J	1200	U	U	89.1	B	J
Thallium	mg/kg	0.96	U	U	0.56	U	U	0.54	U	U	0.73	U	U	0.59	U	U	1.1	U	U
Vanadium	mg/kg	13.5			16.3		J	15.6			10.6			22.4			16		
Zinc	mg/kg	38.7			25.9		J	38			33.3			39.3			48.5		
General Chemistry																			
% Solids	Percent	84.8			83.2			79.4			85.4			80.7			76.1		
Total organic carbon	Percent	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
1) "-" = Not Analyzed
2) "U" = Not Detected
3) LQ = Laboratory Qualifier
4) VQ = Validation Qualifier
5) Laboratory and data validation qualifier definitions are presented in Table 5 of Appendix H.
6) REG = Regular Field Sample
7) FS = Field Split or quality assurance sample delivered to alternate laboratory
8) FD = Field Duplicate or quality control sample delivered to primary laboratory

Appendix G

Ash Pit 3 Groundwater Chemical Analytical Data Summary
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Location:	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
		Sample Number:	AP3083			AP3084			AP3085			AP3088			AP3086			AP3091			AP3087			AP3092		
		Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12			16-Dec-11			30-May-12			20-Dec-11			30-May-12		
		Sample Depth;	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft			10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
		Sample Purpose:	REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Filtered	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Field Tests																										
Ferrous Iron	N	mg/L	0			-	-	-	-	-	-	-	-	-	0			-	-	-	0			-	-	-
Explosives																										
Amino-2,6-dinitrotoluene, 4-	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Amino-4,6-dinitrotoluene, 2-	N	µg/L	0.2	U	U	0.2	U	U	0.1	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Dinitrobenzene, 1,3-	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Dinitrotoluene, 2,4-	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Dinitrotoluene, 2,6-	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
HMX	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Nitrobenzene	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Nitrotoluene, 2-	N	µg/L	0.2	U	U	0.2	U	U	0.1	U	U	0.18	J	J	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Nitrotoluene, 3-	N	µg/L	0.2	U	U	0.2	U	U	0.1	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Nitrotoluene, 4-	N	µg/L	0.2	U	U	0.2	U	U	0.1	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
RDX	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Tetryl	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Trinitrobenzene, 1,3,5-	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Trinitrotoluene, 2,4,6-	N	µg/L	0.2	U	U	0.2	U	U	0.05	U	U	0.4	U	U	0.19	U	U	0.4	U	U	0.2	U	U	0.4	U	U
Volatiles																										
Acetone	N	µg/L	25	U	U	25	U	U	10	U	U	25	U	U	25	U	UJ	25	U	U	17.6	J	J	25	U	U
Benzene	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Bromodichloromethane	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Bromoform	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	UJ	1	U	U	1	U	U	1	U	U
Bromomethane	N	µg/L	2	U	U	2	U	U	1	U	U	2	U	U	2	U	U	2	U	U	2	U	U	2	U	U
Butanone, 2-	N	µg/L	5	U	U	5	U	U	10	U	U	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Carbon disulfide	N	µg/L	2	U	U	2	U	U	1	U	U	2	U	U	2	U	U	2	U	U	2	U	U	2	U	U
Carbon tetrachloride	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	UJ	1	U	U	1	U	UJ	1	U	U	1	U	UJ
Chlorobenzene	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Chloroethane	N	µg/L	2	U	U	2	U	U	1	U	U	2	U	U	2	U	U	2	U	U	2	U	U	2	U	U
Chloroform	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Chloromethane	N	µg/L	2	U	U	2	U	U	1	U	U	2	U	UJ	2	U	U	2	U	U	1.6	J	J	2	U	U
Cyclohexane	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibromo-3-chloropropane, 1,2-	N	µg/L	0			-	-	-	2	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibromochloromethane	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Dibromoethane, 1,2-	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorobenzene, 1,2-	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorobenzene, 1,3-	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorobenzene, 1,4-	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichloroethane, 1,1-	N	µg/L	1.7			1.6			1.3			1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethane, 1,2-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethene, 1,1-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethene, cis-1,2-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethene, trans-1,2-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Dichloropropane, 1,2-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U

Appendix G

Ash Pit 3 Groundwater Chemical Analytical Data Summary
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Location:	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
		Sample Number:	AP3083			AP3084			AP3085			AP3088			AP3086			AP3091			AP3087			AP3092		
		Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12			16-Dec-11			30-May-12			20-Dec-11			30-May-12		
		Sample Depth;	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft			10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
		Sample Purpose:	REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Filtered	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Dichloropropene, cis-1,3-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	UJ	1	U	U	1	U	U	1	U	U
Dichloropropene, trans-1,3-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	UJ	1	U	U	1	U	U	1	U	U
Ethylbenzene	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Hexanone, 2-	N	µg/L	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Isopropylbenzene	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
METHYL ACETATE	N	µg/L	0			-	-	-	10	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methyl Tertiary Butyl Ether	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methyl-2-pentanone, 4-	N	µg/L	5	U	U	5	U	U	10	U	U	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Methylcyclohexane	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylene chloride	N	µg/L	5	U	U	5	U	U	1	U	U	5	U	U	5	U	U	5	U	UJ	5	U	U	5	U	UJ
Styrene	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	UJ	1	U	U	1	U	U	1	U	U
Tetrachloroethane, 1,1,2,2-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Tetrachloroethene	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Toluene	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Trichlorobenzene, 1,2,4-	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethane, 1,1,1-	N	µg/L	0.27	J	J	0.26	J	J	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Trichloroethane, 1,1,2-	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Trichloroethene	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Trichlorofluoromethane	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichlorotrifluoroethane	N	µg/L	0			-	-	-	1	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vinyl chloride	N	µg/L	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Xylenes, total	N	µg/L	3	U	U	3	U	U	2	U	U	3	U	U	3	U	U	3	U	U	3	U	U	3	U	U
Semivolatiles																										
3-Methylphenol and 4-Methylph	N	µg/L	4.8	U	U	4.8	U	U	2	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Acenaphthene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Acenaphthylene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Acetophenone	N	µg/L	0			-	-	-	0.98	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Atrazine	N	µg/L	0			-	-	-	0.98	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzaldehyde	N	µg/L	0			-	-	-	0.98	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Benzo(a)pyrene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Benzo(b)fluoranthene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Benzo(ghi)perylene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Benzo(k)fluoranthene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Benzoic acid	N	µg/L	48	U	U	48	U	U	-	-	-	-	-	-	48	U	U	-	-	-	48	U	U	-	-	-
Benzyl alcohol	N	µg/L	4.8	U	U	4.8	U	U	-	-	-	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Bibenzene	N	µg/L	0			-	-	-	0.98	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-chloroethoxy)methane	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Bis(2-chloroethyl)ether	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Bis(2-chloroisopropyl)ether	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Bis(2-ethylhexyl)phthalate	N	µg/L	4.8	U	U	4.8	U	U	0.8	J B	B	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Bromophenyl phenyl ether, 4-	N	µg/L	4.8	U	U	4.8	U	U	2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Butyl benzyl phthalate	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-

Appendix G

Ash Pit 3 Groundwater Chemical Analytical Data Summary
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Location:	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
		Sample Number:	AP3083			AP3084			AP3085			AP3088			AP3086			AP3091			AP3087			AP3092		
		Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12			16-Dec-11			30-May-12			20-Dec-11			30-May-12		
		Sample Depth;	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft			10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
		Sample Purpose:	REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Filtered	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Caprolactam	N	µg/L	0			-	-	-	4.9	U	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbazole	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Chloro-3-methylphenol, 4-	N	µg/L	4.8	U	U	4.8	U	U	2	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Chloroaniline, 4-	N	µg/L	4.8	U	U	4.8	U	U	2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Chloronaphthalene, 2-	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Chlorophenol, 2-	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Chlorophenyl phenyl ether, 4-	N	µg/L	4.8	U	U	4.8	U	U	2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Chrysene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dibenz(a,h)anthracene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dibenzofuran	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dichlorobenzene, 1,2-	N	µg/L	4.8	U	U	4.8	U	U	-	-	-	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dichlorobenzene, 1,3-	N	µg/L	4.8	U	U	4.8	U	U	-	-	-	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dichlorobenzene, 1,4-	N	µg/L	4.8	U	U	4.8	U	U	-	-	-	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dichlorobenzidine, 3,3'-	N	µg/L	9.5	U	U	9.5	U	U	4.9	U	U	-	-	-	9.6	U	U	-	-	-	9.5	U	U	-	-	-
Dichlorophenol, 2,4-	N	µg/L	4.8	U	U	4.8	U	U	2	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Diethyl phthalate	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dimethyl phthalate	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dimethylphenol, 2,4-	N	µg/L	4.8	U	U	4.8	U	U	2	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Di-n-butyl phthalate	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dinitro-2-methylphenol, 4,6-	N	µg/L	9.5	U	U	9.5	U	U	4.9	U	UJ	-	-	-	9.6	U	U	-	-	-	9.5	U	U	-	-	-
Dinitrophenol, 2,4-	N	µg/L	24	U	U	24	U	U	4.9	U	UJ	-	-	-	24	U	U	-	-	-	24	U	U	-	-	-
Dinitrotoluene, 2,4-	N	µg/L	4.8	U	U	4.8	U	U	4.9	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Dinitrotoluene, 2,6-	N	µg/L	4.8	U	U	4.8	U	U	4.9	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Di-n-octyl phthalate	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Fluoranthene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Fluorene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Hexachlorobenzene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Hexachlorobutadiene	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Hexachlorocyclopentadiene	N	µg/L	9.5	U	U	9.5	U	U	9.8	U	U	-	-	-	9.6	U	U	-	-	-	9.5	U	U	-	-	-
Hexachloroethane	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Indeno(1,2,3-cd)pyrene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Isophorone	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Methylnaphthalene, 2-	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Methylphenol, 2-	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Naphthalene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Nitroaniline, 2-	N	µg/L	4.8	U	U	4.8	U	U	2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Nitroaniline, 3-	N	µg/L	4.8	U	U	4.8	U	U	2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Nitroaniline, 4-	N	µg/L	4.8	U	U	4.8	U	U	2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Nitrobenzene	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Nitrophenol, 2-	N	µg/L	4.8	U	U	4.8	U	U	2	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Nitrophenol, 4-	N	µg/L	24	U	U	24	U	U	4.9	U	UJ	-	-	-	24	U	U	-	-	-	24	U	U	-	-	-
n-Nitroso-di-n-propylamine	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
n-Nitrosodiphenylamine	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Pentachlorophenol	N	µg/L	24	U	U	24	U	U	4.9	U	UJ	-	-	-	24	U	U	-	-	-	24	U	U	-	-	-

Appendix G

Ash Pit 3 Groundwater Chemical Analytical Data Summary
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Location:	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
		Sample Number:	AP3083			AP3084			AP3085			AP3088			AP3086			AP3091			AP3087			AP3092		
		Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12			16-Dec-11			30-May-12			20-Dec-11			30-May-12		
		Sample Depth;	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft			10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
		Sample Purpose:	REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Filtered	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Phenanthrene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Phenol	N	µg/L	4.8	U	U	4.8	U	U	0.98	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Pyrene	N	µg/L	4.8	U	U	4.8	U	U	0.2	U	U	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Trichlorobenzene, 1,2,4-	N	µg/L	4.8	U	U	4.8	U	U	-	-	-	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Trichlorophenol, 2,4,5-	N	µg/L	4.8	U	U	4.8	U	U	4.9	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Trichlorophenol, 2,4,6-	N	µg/L	4.8	U	U	4.8	U	U	4.9	U	UJ	-	-	-	4.8	U	U	-	-	-	4.8	U	U	-	-	-
Metals - Unfiltered																										
Aluminum	N	µg/L	200	U	U	200	U	U	300	U	U	71	B	J	200	U	U	40.2	B	J	88.9	B	J	34.9	B	J
Antimony	N	µg/L	6	U	U	6	U	U	25	U	U	6	U	U	6	U	U	6	U	U	6	U	U	6	U	U
Arsenic	N	µg/L	10	U	U	10	U	U	10	U	U	9.9	B	J	10	U		5.2	B	J	10	U	U	10	U	U
Barium	N	µg/L	40.6	B	J	39.5	B	J	45	J	J	110	B	J	220		J	113	B	J	67	B	J	47.5	B	J
Beryllium	N	µg/L	4	U	U	4	U	U	5	U	U	4	U	U	4	U	U	4	U	U	4	U	U	4	U	U
Cadmium	N	µg/L	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Calcium	N	µg/L	117000		J	121000		J	130000			116000			140000		J	118000			161000		J	157000		
Chromium	N	µg/L	10	U	U	10	U	U	7	U	U	10	U	U	1.3	B	J	10	U	U	10	U	U	10	U	U
Cobalt	N	µg/L	1.2	B	J	1.1	B	J	1.7	J	J	50	U	U	50	U	U	2.1	B	J	50	U	U	1.6	B	J
Copper	N	µg/L	25	U	U	25	U	U	25	U	U	25	U	U	25	U	U	25	U	U	25	U	U	25	U	U
Iron	N	µg/L	57.5	B	J	70.6	B	J	130	J	J	2240			300	U	U	661			300	U	UJ	631		
Lead	N	µg/L	5	U	U	5	U	U	10	U	U	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Magnesium	N	µg/L	25900		J	27700		J	29000	B		45900			71600		J	66300			51200		J	55200		
Manganese	N	µg/L	1760			1780			1900			779			52			270			151			472		
Mercury	N	µg/L	1	U	U	1	U	U	0.2	U	U	1	U	U	1	U	U	1	U	U	1	U	U	1	U	U
Nickel	N	µg/L	40	U	U	40	U	U	40	U	U	40	U	U	40	U	U	40	U	U	2.4	B	J	40	U	U
Potassium	N	µg/L	805	B	J	716	B	J	900	J	J	4050	B	J	3840	B	J	5030	B	J	11100			4680	B	J
Selenium	N	µg/L	10	U	U	10	U	U	15	U	U	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Silver	N	µg/L	10	U	U	10	U	U	7	U	U	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Sodium	N	µg/L	20100			19500			20000			20100			23300			40100			154000			105000		
Thallium	N	µg/L	10	U	U	10	U	U	30	U	U	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Vanadium	N	µg/L	50	U	U	50	U	U	7	U	U	50	U	U	2.1	B	J	50	U	U	2.1	B	J	50	U	U
Zinc	N	µg/L	20	U	U	20	U	U	50	U	U	15.1	B	J	7.6	B	J	13	B	J	7.7	B	J	18.4	B	J
Metals - Filtered																										
Aluminum	Y	µg/L	200	U	U	200	U	U	300	U	U	-	-	-	-	-	-	-	-	-	46.7	B	J	-	-	-
Antimony	Y	µg/L	6	U	U	6	U	U	25	U	U	-	-	-	-	-	-	-	-	-	6	U	U	-	-	-
Arsenic	Y	µg/L	10	U	U	10	U	U	4.1	J	J	-	-	-	-	-	-	-	-	-	10	U	U	-	-	-
Barium	Y	µg/L	40.5	B	J	43.5	B	J	46	J	J	-	-	-	-	-	-	-	-	-	75.3	B	J	-	-	-
Beryllium	Y	µg/L	4	U	U	4	U	U	5	U	U	-	-	-	-	-	-	-	-	-	4	U	U	-	-	-
Cadmium	Y	µg/L	5	U	U	5	U	U	5	U	U	-	-	-	-	-	-	-	-	-	5	U	U	-	-	-
Calcium	Y	µg/L	119000			125000			130000			-	-	-	-	-	-	-	-	-	169000			-	-	-
Chromium	Y	µg/L	10	U	U	10	U	U	7	U	U	-	-	-	-	-	-	-	-	-	10	U	U	-	-	-
Cobalt	Y	µg/L	1.4	B	J	1.3	B	J	7	U	U	-	-	-	-	-	-	-	-	-	50	U	U	-	-	-
Copper	Y	µg/L	7.3	B	J	25	U	U	25	U	U	-	-	-	-	-	-	-	-	-	25	U	U	-	-	-
Iron	Y	µg/L	74.1	B	J	67.4	B	J	81	J	J	-	-	-	-	-	-	-	-	-	300	U	U	-	-	-
Lead	Y	µg/L	5	U	U	5	U	U	10	U	U	-	-	-	-	-	-	-	-	-	5	U	U	-	-	-
Magnesium	Y	µg/L	27400			29000			29000	B		-	-	-	-	-	-	-	-	-	54100			-	-	-

Appendix G

Ash Pit 3 Groundwater Chemical Analytical Data Summary
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Location:	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
		Sample Number:	AP3083			AP3084			AP3085			AP3088			AP3086			AP3091			AP3087			AP3092		
		Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12			16-Dec-11			30-May-12			20-Dec-11			30-May-12		
		Sample Depth;	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft			10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
		Sample Purpose:	REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Filtered	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Manganese	Y	µg/L	1720			1800			1900			-	-	-	-	-	-	-	-	-	151			-	-	-
Mercury	Y	µg/L	1	U	U	1	U	U	0.2	U	U	-	-	-	-	-	-	-	-	-	1	U	U	-	-	-
Nickel	Y	µg/L	40	U	U	40	U	U	40	U	U	-	-	-	-	-	-	-	-	-	40	U	U	-	-	-
Potassium	Y	µg/L	744	B	J	766	B	J	860	J	J	-	-	-	-	-	-	-	-	-	11300			-	-	-
Selenium	Y	µg/L	10	U	U	10	U	U	15	U	U	-	-	-	-	-	-	-	-	-	2.9	B	J	-	-	-
Silver	Y	µg/L	10	U	U	10	U	U	7	U	U	-	-	-	-	-	-	-	-	-	10	U	U	-	-	-
Sodium	Y	µg/L	19800			21300			19000			-	-	-	-	-	-	-	-	-	153000			-	-	-
Thallium	Y	µg/L	10	U	U	10	U	U	30	U	U	-	-	-	-	-	-	-	-	-	10	U	U	-	-	-
Vanadium	Y	µg/L	50	U	U	50	U	U	7	U	U	-	-	-	-	-	-	-	-	-	2.4	B	J	-	-	-
Zinc	Y	µg/L	20	U	U	20	U	U	50	U	U	-	-	-	-	-	-	-	-	-	20	U	U	-	-	-
Water Quality Parameters																										
Alkalinity, Carbonate	N	µg/L	302000		J	305000		J	300			-	-	-	392000			-	-	-	398000		J	-	-	-
Chloride	N	ppm	1.8	B	J	1.7	B	J	1.7			-	-	-	11			-	-	-	27			-	-	-
Cyanide, total	N	ppm	0.01	U	U	0.01	U	U	0.01	U	U	-	-	-	0.01	U	U	-	-	-	0.01	U	U	-	-	-
Hardness (as CaCO3)	N	ppm	399			416			470			479			644			568			613			619		
Nitrate-Nitrite	N	ppm	0.1	U	U	0.052	B	J	0.065	J B	B	-	-	-	0.53			-	-	-	0.42			-	-	-
Sulfate	N	ppm	162		J	167		J	180			-	-	-	305			-	-	-	538			-	-	-
Total dissolved solids	N	ppm	557		J	398		J	530			-	-	-	788			-	-	-	1210			-	-	-
Total suspended solids	N	ppm	10	U	U	10	U	U	4	U	U	-	-	-	10	U	U	-	-	-	8	B	J	-	-	-
Turbidity	N	NTU	1	U	U	1	U	U	1	H		-	-	-	1.2			-	-	-	1	U	U	-	-	-

Notes:
1) "-" = Not Analyzed
2) "U" = Not Detected
3) LQ = Laboratory Qualifier
4) VQ = Validation Qualifier
5) Laboratory and data validation qualifier definitions are presented in Table 5 of Appendix H.
6) REG = Regular Field Sample
7) FD = Field Duplicate or quality control sample delivered to primary laboratory.
8) FS = Field Split or quality assurance sample delivered to alternate laboratory.

APPENDIX H

DETECTED HITS SUMMARY

Appendix H

Coal Yard 3 Detected Hits Summary
Former Plum Brook Ordnanace Works, Sandusky, Ohio

Sample Location:		CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB01			CY3-SB02			CY3-SB02			CY3-SB02			CY3-SB03		
Sample Number:		CY0031			CY0032			CY0033			CY0034			CY0035			CY0036			CY0037			CY0038			CY0039		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		.2 - 1.2 Ft			3 - 5 Ft			3 - 5 Ft			3 - 5 Ft			8 - 10 Ft			1.5 - 2.5 Ft			3 - 5 Ft			8 - 10 Ft			0 - 1 Ft		
Sample Purpose:		REG			REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Semivolatiles																													
Acenaphthylene	mg/kg	0.0657	J	J	U	U	U	U	U	U	U	U	U	U	U	U	0.0619	J	J	U	U	U	U	U	U	U	U	U
Anthracene	mg/kg	0.171	J	J	U	U	U	U	U	U	U	U	U	U	U	U	0.0738	J	J	U	U	U	U	U	U	U	U	U
Benzo(a)anthracene	mg/kg	0.407			U	U	U	U	U	U	U	U	U	U	U	U	0.348			U	U	U	U	U	U	0.0366	J	J
Benzo(a)pyrene	mg/kg	0.326			U	U	U	U	U	U	U	U	U	U	U	U	0.403			U	U	U	U	U	U	0.032	J	J
Benzo(b)fluoranthene	mg/kg	0.414			U	U	U	U	U	U	U	U	U	U	U	U	0.582			U	U	U	U	U	U	0.0291	J	J
Benzo(ghi)perylene	mg/kg	0.203			U	U	U	U	U	U	U	U	U	U	U	U	0.277			U	U	U	U	U	U	0.0224	J	J
Benzo(k)fluoranthene	mg/kg	0.163	J	J	U	U	U	U	U	U	U	U	U	U	U	U	0.188	J	J	U	U	U	U	U	U	0.0269	J	J
Chrysene	mg/kg	0.387			U	U	U	U	U	U	U	U	U	U	U	U	0.443			U	U	U	U	U	U	0.0406	J	J
Dibenz(a,h)anthracene	mg/kg	0.0416	J	J	U	U	U	U	U	U	U	U	U	U	U	U	0.0589	J	J	U	U	U	U	U	U	U	U	U
Fluoranthene	mg/kg	0.843			U	U	U	U	U	U	U	U	U	U	U	U	0.662			U	U	U	U	U	U	0.0525	J	J
Indeno(1,2,3-cd)pyrene	mg/kg	0.223			U	U	U	U	U	U	U	U	U	U	U	U	0.294			U	U	U	U	U	U	0.0255	J	J
Methylnaphthalene, 2-	mg/kg	U	U	U	U	U	U	U	U	U	0.01			U	U	U	U	U	U	U	U	U	U	U	U	0.021	J	J
Phenanthrene	mg/kg	0.415			U	U	U	U	U	U	U	U	U	U	U	U	0.249			U	U	U	U	U	U	0.0278	J	J
Pyrene	mg/kg	0.636			U	U	U	U	U	U	U	U	U	U	U	U	0.508			U	U	U	U	U	U	0.0438	J	J
Metals - Unfiltered																													
Aluminum	mg/kg	7110			11400			11400			8700			6040			4130			8230			6530			5780		
Antimony	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.15	B	J	U	U	U
Arsenic	mg/kg	8.8			8.7			12.9			4.2			8.6			3.6			7.5			5.6			7.2		
Barium	mg/kg	44.7			64.3			70.7			61			53.2			19.3			58.2			50.2			37.4		
Beryllium	mg/kg	0.42	B	J	0.7	B	J	0.61	B	J	0.18	J	J	0.3			0.19	B	J	0.49			0.38			0.3		
Cadmium	mg/kg	0.16	B	J	U	U	U	U	U	U	0.054	J	J	0.11	B	J	U	U	U	U	U	U	0.42			0.18	B	J
Calcium	mg/kg	20200			2740			3260			2700		J	40300			68000			2340			14000			38500		
Chromium	mg/kg	9.6			15.6			17.2			12		J	10.7			6.7			12.1			9.4			10.3		
Cobalt	mg/kg	8.1			8.6	B	J	8.4	B	J	6			5.5			2.7			5.9			6.1			6.7		
Copper	mg/kg	15.2			13.2			19.5			9.2		J	14.3			7.4			12.2			13			14.7		
Iron	mg/kg	14500			18700			25800			14000			11600			6480			15000			12100			12100		
Lead	mg/kg	11			8.6			9.7			5.7			9.7			5.8			9.3			9.7			10		
Magnesium	mg/kg	5920			2250			1970			2000	B		12000			5020			1600			6010			10900		
Manganese	mg/kg	316			426			291			230		J	274			240			251			269			325		
Mercury	mg/kg	0.029	B	J	0.021	B	J	0.049	B	J	0.022	J	J	0.013	B	J	0.03	B	J	0.033	B	J	0.022	B	J	0.018	B	J
Nickel	mg/kg	19.8			19.6			23.9			13			14.8			5.8			15.6			14.6			17.5		
Potassium	mg/kg	755	B	J	697	B	J	598	B	J	550	J	J	982			273	B	J	478	B	J	465	B	J	921		
Sodium	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	91.5	B	J	57	B	J	U	U	U	55.7	B	J	92.1	B	J
Thallium	mg/kg	U	U	U	U	U	U	U	U	U	1	J	J	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Vanadium	mg/kg	16.2			27.3			33.4			19			12.2			10.7			23.7			16.2			13.5		
Zinc	mg/kg	48.9			38.5			50.4			30		J	38.3			14.6			30.9			29			38.7		
General Chemistry																													
% Solids	Percent	85.1			81			80.1			-	-	-	80.5			83			81.7			77.1			84.8		
Total organic carbon	Percent	0.66			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
1) "-" = Not Analyzed
2) "U" = Not Detected
3) LQ = Laboratory Qualifier
4) VQ = Validation Qualifier
5) Laboratory and data validation qualifier definitions are presented in Table 5 of Appendix H.
6) REG = Regular Field Sample
7) FD = Field Duplicate
8) FS = Field Split

Appendix H

Coal Yard 3 Detected Hits Summary
Former Plum Brook Ordnanace Works, Sandusky, Ohio

Sample Location:		CY3-SB03			CY3-SB03			CY3-SB04			CY3-SB04			CY3-SB04		
Sample Number:		CY0040			CY0041			CY0042			CY0043			CY0044		
Sample Date:		19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11			19-Dec-11		
Sample Depth:		3 - 5 Ft			8 - 10 Ft			0 - 1 Ft			3 - 5 Ft			8 - 10 Ft		
Sample Purpose:		REG			REG			REG			REG			REG		
Parameter	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Semivolatiles																
Acenaphthylene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Anthracene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzo(a)anthracene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzo(a)pyrene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzo(b)fluoranthene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzo(ghi)perylene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzo(k)fluoranthene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Chrysene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Dibenz(a,h)anthracene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Fluoranthene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Indeno(1,2,3-cd)pyrene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Methylnaphthalene, 2-	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Phenanthrene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Pyrene	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Metals - Unfiltered																
Aluminum	mg/kg	7270		J	7100			4640			8390			7330		
Antimony	mg/kg	U	U	U	0.29	B	J	U	U	U	U	U	U	U	U	U
Arsenic	mg/kg	3.7		J	4.8			4.9			7.8			7.3		
Barium	mg/kg	51		J	46.1			42.4			66.3			59.6		
Beryllium	mg/kg	0.38		J	0.37			0.25			0.49	B	J	0.38		
Cadmium	mg/kg	0.26		J	0.61			0.14	B	J	U	U	U	0.21	B	J
Calcium	mg/kg	2850		J	28500			31800			2860			42700		
Chromium	mg/kg	9.1		J	10.4			8.6			12.6			14.3		
Cobalt	mg/kg	3.6		J	6.2			4.7			6.7			9		
Copper	mg/kg	10.5		J	16.1			12			15.7			18.9		
Iron	mg/kg	9520		J	13600			8830			16400			13900		
Lead	mg/kg	9.4		J	10			9.9			9.4			12.8		
Magnesium	mg/kg	1450		J	9740			9390			1990			12900		
Manganese	mg/kg	158		J	346			236			436			400		
Mercury	mg/kg	0.05	B	J	0.019	B	J	0.02	B	J	0.034	B	J	0.015	B	J
Nickel	mg/kg	8.8		J	17.3			12			18.7			21.6		
Potassium	mg/kg	387	B	J	929			558			454	B	J	1010		
Sodium	mg/kg	U	U	U	76.9	B	J	70	B	J	U	U	U	89.1	B	J
Thallium	mg/kg	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Vanadium	mg/kg	16.3		J	15.6			10.6			22.4			16		
Zinc	mg/kg	25.9		J	38			33.3			39.3			48.5		
General Chemistry																
% Solids	Percent	83.2			79.4			85.4			80.7			76.1		
Total organic carbon	Percent	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
1) "-" = Not Analyzed
2) "U" = Not Detected
3) LQ = Laboratory Qualifier
4) VQ = Validation Qualifier
5) Laboratory and data validation qu

Appendix H

Ash Pit 3 Groundwater Detected Hits Summary
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Location:	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
		Sample Number:	AP3083			AP3084			AP3085			AP3088			AP3086			AP3091			AP3087			AP3092		
		Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12			16-Dec-11			30-May-12			20-Dec-11			30-May-12		
		Sample Depth:	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft			10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
		Sample Purpose:	REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Filtered	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Field Tests																										
Ferrous Iron	N	mg/L	0			-	-	-	-	-	-	-	-	-	0			-	-	-	0			-	-	-
Explosives																										
Nitrotoluene, 2-	N	µg/L	U	U	U	U	U	U	U	U	U	0.18	J	J	U	U	U	U	U	U	U	U	U	U	U	U
Volatiles																										
Acetone	N	µg/L	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	17.6	J	J	U	U	U
Chloromethane	N	µg/L	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	1.6	J	J	U	U	U
Dichloroethane, 1,1-	N	µg/L	1.7			1.6			1.3			U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethane, 1,1,1	N	µg/L	0.27	J	J	0.26	J	J	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Semivolatiles																										
Bis(2-ethylhexyl)phtha	N	µg/L	U	U	U	U	U	U	0.8	J B	B	-	-	-	U	U	U	-	-	-	U	U	U	-	-	-
Metals - Unfiltered																										
Aluminum	N	µg/L	U	U	U	U	U	U	U	U	U	71	B	J	U	U	U	40.2	B	J	88.9	B	J	34.9	B	J
Arsenic	N	µg/L	U	U	U	U	U	U	U	U	U	9.9	B	J	U	U	U	5.2	B	J	U	U	U	U	U	U
Barium	N	µg/L	40.6	B	J	39.5	B	J	45	J	J	110	B	J	220		J	113	B	J	67	B	J	47.5	B	J
Calcium	N	µg/L	117000		J	121,000		J	130,000			116,000			140,000		J	118,000			161,000		J	157,000		
Chromium	N	µg/L	U	U	U	U	U	U	U	U	U	U	U	U	1.3	B	J	U	U	U	U	U	U	U	U	U
Cobalt	N	µg/L	1.2	B	J	1.1	B	J	1.7	J	J	U	U	U	U	U	U	2.1	B	J	U	U	U	1.6	B	J
Copper	N	µg/L	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Iron	N	µg/L	57.5	B	J	70.6	B	J	130	J	J	2,240			U	U	U	661			U	U	U	631		
Magnesium	N	µg/L	25900		J	27,700		J	29,000	B		45,900			71,600		J	66,300			51,200		J	55,200		
Manganese	N	µg/L	1760			1,780			1,900			779			52			270			151			472		
Nickel	N	µg/L	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	2.4	B	J	U	U	U
Potassium	N	µg/L	805	B	J	716	B	J	900	J	J	4,050	B	J	3,840	B	J	5,030	B	J	11,100			4,680	B	J
Selenium	N	µg/L	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Sodium	N	µg/L	20100			19,500			20,000			20,100			23,300			40,100			154,000			105,000		
Vanadium	N	µg/L	U	U	U	U	U	U	U	U	U	U	U	U	2.1	B	J	U	U	U	2.1	B	J	U	U	U
Zinc	N	µg/L	U	U	U	U	U	U	U	U	U	15.1	B	J	7.6	B	J	13	B	J	7.7	B	J	18.4	B	J
Metals - Filtered																										
Aluminum	Y	µg/L	U	U	U	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	46.7	B	J	-	-	-
Arsenic	Y	µg/L	U	U	U	U	U	U	4.1	J	J	-	-	-	-	-	-	-	-	-	U	U	U	-	-	-
Barium	Y	µg/L	40.5	B	J	43.5	B	J	46	J	J	-	-	-	-	-	-	-	-	-	75.3	B	J	-	-	-
Calcium	Y	µg/L	119000			125,000			130,000			-	-	-	-	-	-	-	-	-	169,000			-	-	-
Chromium	Y	µg/L	U	U	U	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	U	U	U	-	-	-
Cobalt	Y	µg/L	1.4	B	J	1.3	B	J	U	U	U	-	-	-	-	-	-	-	-	-	U	U	U	-	-	-
Copper	Y	µg/L	7.3	B	J	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	U	U	U	-	-	-
Iron	Y	µg/L	74.1	B	J	67.4	B	J	81	J	J	-	-	-	-	-	-	-	-	-	U	U	U	-	-	-
Magnesium	Y	µg/L	27400			29,000			29,000	B		-	-	-	-	-	-	-	-	-	54,100			-	-	-
Manganese	Y	µg/L	1720			1,800			1,900			-	-	-	-	-	-	-	-	-	151			-	-	-

Appendix H

Ash Pit 3 Groundwater Detected Hits Summary
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Location:	AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW01			AP3-MW02			AP3-MW02			AP3-MW03			AP3-MW03		
		Sample Number:	AP3083			AP3084			AP3085			AP3088			AP3086			AP3091			AP3087			AP3092		
		Sample Date:	19-Dec-11			19-Dec-11			19-Dec-11			30-May-12			16-Dec-11			30-May-12			20-Dec-11			30-May-12		
		Sample Depth:	1.3 - 1.3 Ft			1.3 - 1.3 Ft			1.3 - 1.3 Ft			0 - 0 Ft			10.02 - 10.19 Ft			0 - 0 Ft			7.22 - 7.41 Ft			0 - 0 Ft		
		Sample Purpose:	REG			FD			FS			REG			REG			REG			REG			REG		
Parameter	Filtered	Units	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ	Result	LQ	VQ
Nickel	Y	µg/L	U	U	U	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	U	U	U	-	-	-
Potassium	Y	µg/L	744	B	J	766	B	J	860	J	J	-	-	-	-	-	-	-	-	-	11,300			-	-	-
Selenium	Y	µg/L	U	U	U	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	2.9	B	J	-	-	-
Sodium	Y	µg/L	19800			21,300			19,000			-	-	-	-	-	-	-	-	-	153,000			-	-	-
Vanadium	Y	µg/L	U	U	U	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	2.4	B	J	-	-	-
Zinc	Y	µg/L	U	U	U	U	U	U	U	U	U	-	-	-	-	-	-	-	-	-	U	U	U	-	-	-
Water Quality Parameters																										
Alkalinity, Carbonate	N	µg/L	302000		J	305,000		J	300,000			-	-	-	392,000			-	-	-	398,000		J	-	-	-
Chloride	N	µg/L	1800	B	J	1,700	B	J	1,700			-	-	-	11,000			-	-	-	27,000			-	-	-
Hardness (as CaCO3)	N	µg/L	399000			416,000			470,000			479,000			644,000			568,000			613,000			619,000		
Nitrate-Nitrite	N	µg/L	U	U	U	52	B	J	65	J B	B	-	-	-	530			-	-	-	420			-	-	-
Sulfate	N	µg/L	162000		J	167,000		J	180,000			-	-	-	305,000			-	-	-	538,000			-	-	-
Total dissolved solids	N	µg/L	557000		J	398,000		J	530,000			-	-	-	788,000			-	-	-	1,210,000			-	-	-
Total suspended solids	N	µg/L	U	U	U	U	U	U	U	U	U	-	-	-	U	U	U	-	-	-	8,000	B	J	-	-	-
Turbidity	N	NTU	U	U	U	U	U	U	1	H		-	-	-	1.2			-	-	-	U	U	U	-	-	-

Notes:
1) "-" = Not Analyzed
2) "U" = Not Detected
3) LQ = Laboratory Qualifier
4) VQ = Validation Qualifier
5) Laboratory and data validation qualifier definitions are presented in Table 5 of Appendix H.
6) REG = Regular Field Sample
7) FD = Field Duplicate
8) FS = Field Split

APPENDIX I

DATA QUALITY EVALUATIONS

DATA QUALITY EVALUATION

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List of Acronyms

AR/COC	analysis request/chain of custody
CCAL	continuing calibration
CFR	Code of Federal Regulations
CI	chemical investigation
DI	deionized
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
ICAL	initial calibration
ICS	Interference Check Sample
ID	identification
LCS	laboratory control sample
MB	material blank or method blank
MDL	method detection limit
MQL	method quantitation limit
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
NFG	national functional guidelines
PBOW	Plum Brook Ordnance Works
PQL	practical quanitation limit
QA/QC	quality assurance/quality control
SAP	quality assurance project plan
RI	remedial investigation
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SOP	standard operating procedures
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compounds

1.0 Introduction

This appendix presents results of the quality assurance/quality control (QA/QC) measures implemented for the sampling and analysis activities at the Plum Brook Ordnance Works (PBOW), Sandusky, Ohio. The quality indicators from every aspect of the data collection were reviewed, and an assessment of the data with regard to project-specific objectives is presented. Successful execution of project-specific objectives and procedures provides strong support for the acceptance of the data generated as adequate for the purpose of evaluating the analytical results from this assessment at PBOW.

Shaw Environmental, Inc. (Shaw) conducted investigative work at the Coal Yard 3 area; sampling was performed December 2011. Primary and field duplicate project samples were analyzed by Accutest Laboratories, of Orlando, Florida. Field Split samples were submitted to Test America Laboratories, Inc. of North Canton, Ohio for analysis. All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following the guidelines in the *EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, June 2008 (EPA, 2008), the QAPP (Shaw, 2008c), and *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*, (April 1993). Since these documents specify procedures for Contract Laboratory Program (CLP) data, they are used as guidelines only. Method and laboratory quality assurance and quality control requirements supercede these guidelines, where applicable. Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness and comparability goals established to meet the project data quality objectives (DQO). To verify that these DQOs were met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and all nonconformances and discrepancies in the data were examined to determine compliance with the appropriate and applicable procedures defined in the SAP. The results of this review are presented in the following sections, with all analytical outliers or nonconformances discussed where they occurred.

This report is divided into three subsections. Section 2.0 discusses the field investigation and QC procedures used during the sampling effort. Section 3.0 outlines the analytical program and the associated QC activities performed. The final part of this document, Section 4.0, summarizes the data findings and their overall impact on the usability of the analytical data.

2.0 Field Sampling and QC Activities

Shaw was retained by the U. S. Army Corps of Engineers, Nashville District to conduct investigative and sampling activities at PBOW. Field activities at this site included collection of soil samples. The collection of these samples and their associated QC samples are discussed in this section of the Data Quality Evaluation (DQE). Twelve project samples and one field duplicate soil sample were submitted to Accutest for analysis. Sample shipments from the field were performed under custody and documented using standard Shaw Analysis Request/Chain of Custody (AR/COC) forms. These forms provided project-specific analytical specifications and QC instructions to the laboratory. A formal COC transfer record was prepared and included with these forms to document custody during sample transportation, storage, and disposition by the laboratory. Table 1 summarizes the field sample number, location, sample type, date of collection, lot number, and laboratory for each sample collected.

2.1 Equipment Rinsates

Equipment rinsates are used to assess the effectiveness of the decontamination procedures used by the sampling team on reusable sampling equipment. No equipment rinsate samples were collected during this sampling event.

2.2 Field Duplicates

Field duplicate samples are collected and submitted to the laboratory for analysis along with their corresponding original sample. The data generated from the analysis of field duplicate samples are used to evaluate the precision of the sample collection and analysis procedures. It is difficult to collect and analyze soil samples in duplicate due to the heterogeneous nature of soil. High relative percent difference (RPD) between an original sample and its field duplicate may indicate a difference in sample matrix or sample collection rather than true problems with precision of sample analysis. Also, when estimated “J” or nondetected “U” results are reported, there is a potential for increased variability between the primary and duplicate sample results.

Field duplicate samples were collected at a frequency of one for every ten samples (10 percent). One field duplicate soil sample was collected during this sampling event. Table 2 compares the original and field duplicate results and shows the RPDs calculated for those detected compounds. Compounds not presented in the table were not detected in either the original or field duplicate samples. Sample sets with no detections are not presented in the table. In cases where duplicates were performed and one result is less than the reporting limit but greater than the

method detection limit, the RPD is reported, but is of limited value. Only samples with detections in both the regular and the duplicate were qualified for high RPDs.

The acceptance criterion of 30 percent RPD for waters and 50 percent RPD for soils was used to evaluate these sample results. Overall, the data compared well when detected concentrations were greater than the reporting limit. Data that fell outside acceptable criteria are listed in the following table:

SDG	Samples Affected	Analyte(s)	Validation Qualifier
F88938	CY0032(original), CY0033(FD)	Mercury	J

RPD is calculated by using the following formula:

$$RPD = \left| \frac{A - B}{(A + B)/2} \right| \quad x \quad 100$$

where:

RPD = relative percent difference
A = original result
B = field duplicate result.

2.3 Field Split Samples

Split samples were collected in conjunction with field duplicate samples and sent to Test America Laboratories, Inc. of North Canton. The split samples were submitted to the laboratory for the same analysis as their corresponding field duplicates and original field samples. The split samples are used to determine if data results are reproducible when analyzed by two different laboratories. Results are also evaluated to determine if a contracted laboratory's preparation and analysis procedures are in control and meet the approved method criteria.

Field split samples were collected at a frequency of approximately one for every ten regular samples. One soil field split sample was collected during this sampling event. Table 2 compares the original and field split results and shows the RPDs calculated for those detected compounds. Compounds not presented in the table were not detected in either the original or field split

samples. Samples with no detections are not presented in the table. Field split samples were not qualified for RPD criterion.

3.0 Analytical Program and QC Activities

The project QA/QC program described in the SAP was followed for the collection and laboratory analysis of samples. Each of the analytical methods used require that method-specific QA/QC protocols be followed during sample analysis. These protocols are a critical part of the methods employed and were followed by the laboratory during sample analysis. Specific measures included detailed record keeping procedures, instrument calibrations, and analysis of method blanks, blank spikes, MS/MSD, surrogates, and internal standards. The following SW-846 and USEPA methods were used to analyze PBOW samples:

Analysis	Method
Semivolatiles	SW-846 3550C/8270D
Nitroaromatics	SW-846 8330A
Metals	SW-846 3050B/6010C/7471B
Polychlorinated Biphenyls	SW-846 3550C8082A
Wet Chemistry	TOC by Walkley Black (Total Organic Carbon)

The validator used the QA/QC criteria defined in the SAP, laboratory-derived acceptance criteria, and analytical method criteria to qualify data. Any qualifiers added to these data by the data validator are included in the data summary report.

3.1 Laboratory QA/QC Procedures

The following sections discuss specific QA/QC protocols required and performed by the laboratory during this investigation.

3.1.1 Calibration

The calibration of instruments is required to ensure that the instruments are operating properly. Calibration is achieved when instrument response can be related to the concentration of an analyte. All analytes met QC criteria for ICAL percent relative standard deviation and/or CCAL percent difference. The criteria used to evaluate the data are: individual ICAL percent relative standard deviation <+/- 30% and/or CCAL percent difference <+/- 20% (volatile and semivolatile organics); <+/-15% (explosives); for metals, individual ICAL/CCAL percent

relative standard deviation <+/- 10%; and for mercury, individual ICAL/CCAL percent relative standard deviation <+/-20%. No sample qualification was required.

3.1.2 Method/Calibration Blanks

Method blanks are analyzed with each analytical "batch" processed on a per matrix (i.e., soil and water) basis. Method blanks are carried step-wise through the same analytical procedure as their associated field samples including the addition of solvents, surrogate and standard spikes, and reagents as required in the analysis process. The purpose of a method blank is to identify any contaminants that may be introduced to the sample as a result of the analytical process. The method blank is considered acceptable by the laboratory if the concentration of any target analyte is less than ½ the reporting limit and less than 1/10 the amount measure in any sample or regulatory limit (whichever is greater). The data validator evaluated all blank data associated with each sample. The data validators evaluated all blank data associated with each sample. The third party data validation evaluation criteria for method blanks are as follows:

- If a parameter is found in a blank but not detected in the sample, no action is taken.
- For organics, if the sample result is less than 5 times (most analytes) or 10 times (common laboratory contaminants) that of the blank result, the sample result is qualified “B.”
- For inorganics, if the sample result is greater than the instrument detection limit but less than 5 times the blank result, the sample result is qualified "B."

If the sample result is greater than 5 times (most analytes) or 10 times (common laboratory contaminants) the blank result, no action is taken. All method blanks were found to be acceptable.

3.1.3 Surrogate Recoveries

Surrogate standards are defined as non-target compounds added to standards, blanks, and samples prior to extraction or purging. They are used in organic analyses to monitor the percent recovery efficiencies of the sample preparation and analytical procedures. Surrogate recoveries for the project samples all fell within acceptable QC criteria. The surrogate control limits for this project can be found in Attachment A of Appendix E. The surrogate control limits used for evaluation are the laboratory established in-house surrogate criteria.

3.1.4 Matrix Spikes and Laboratory Control Spikes

Two types of spikes were performed for all analyses: matrix spikes (MS) and laboratory control samples (LCS). MS compounds are spiked into an aliquot of a field sample. LCS compounds are spiked into a blank matrix. The spiked compounds are representative compounds that are quantified during performance of the method. Recovery of the spiked compound is used as an assessment of analytical accuracy for the sample matrix analyzed. These results are useful in distinguishing sample matrix interferences from analysis interferences through a comparison of MS and LCS recovery data. Often, spikes are performed in duplicate as a matrix spike duplicate (MSD) or LCS duplicate. In this manner, the precision of the assessment can be quantified as the RPD of the original and duplicate spike.

Matrix spikes were assigned at a frequency of at least 1 for every 20 field samples collected. Two MS/MSD pairs, CY0034-MS/MSD and CY0040-MS/MSD, were assigned to samples. Additional sample volume was provided to the laboratory for the MS/MSD analyses. This sampling frequency meets the collection criteria for this program as specified in the SAP. In addition to the overall collection frequency, the analytical method requires that the laboratory analyze 1 set of spikes per analytical batch. To comply with this method requirement, the laboratory may analyze additional MS/MSD pairs. The validator evaluated all batch QC. The laboratory's statistically determined target acceptance limits were used to assess the spike recovery and RPD.

The following MS/MSD recoveries are outside of established QC criteria:

SDG Number	Sample(s) Affected	Analyte(s)	Validation Qualifier
F88938	CY0040	Benzoic Acid, Isophorone	J/UJ
F88938	CY0040	Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Magnesium, Nickel, Potassium, Selenium, Silver, Sodium, Vanadium, Zinc	J/UJ
240-7168-1	CY0034	Calcium, Chromium, Copper, Manganese, Antimony, Zinc	J/UJ

LCS results are used to evaluate lab method performance in the same manner as the MS/MSD results except the LCS is not performed on an actual field sample matrix. The LCS is prepared for each analytical batch and for each parameter and matrix analyzed. All LCS recoveries met QC criteria.

The LCS and MS/MSD control limits for this project can be found in Attachment A of Appendix E. The LCS and MS/MSD control used for evaluation are the laboratory established in-house control limits. Detected constituents with associated MS/MSD or LCS recoveries above or below the QC limits were qualified as estimated “J”. Sample results with associated MS/MSD or LCS recoveries below the QC limits were qualified as estimated non-detects “UJ”.

3.1.5 Laboratory Duplicate Sample Analysis

Laboratory Duplicate determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate sample analyses are also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. Laboratory duplicates are not required for nitoraromatic analysis. All laboratory duplicate sample analysis met QC criteria with the following exception(s):

SDG Number	Samples Affected	Analyte(s)	Validation Qualifier
F88938	CY0040	Calcium, Manganese	J

3.1.6 Column Agreement

For high performance liquid chromatography (HPLC) analyses, sample results are confirmed using two dissimilar columns. In order for an analyte to be reported, it must be detected on both columns. Results differing by greater than 40 percent are qualified estimated, "J"; however, for this sampling event, all detections were in agreement.

3.1.7 Interference Check Sample and Post Digestion Spike

The ICP Interference Check Sample (ICS) verifies the contract laboratory’s interelement and background correction factors. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and solution AB consists of the analytes mixed with the interferents. An ICS analysis consists of analyzing both solutions consecutively, starting with solution A, for all wavelengths used for each analyte reported by ICP. Results for the ICP analysis of the ICS solution AB must fall within the control limits of $\pm$ 20% of the true value for the analytes included in the solution. All Interference Check Sample (ICS) percent recoveries were acceptable.

Post Digestion spikes are elements added to a portion of a prepared sample to verify the absence or presence of matrix effects for ICP and ICP/MS analysis. To verify the absence of interference,

the spike recovery must be between 75% and 125%. Results outside the acceptance limits require a method of standard additions (MSA) for all samples within the batch. All post digestion spike recoveries were found to be acceptable.

3.1.8 Inductively Coupled Plasma Serial Dilutions

The ICP serial dilution analysis is performed to determine whether or not significant physical or chemical interferences exist due to sample matrix. All QC criteria were met for the serial dilutions associated with the project samples, with the following exception(s):

SDG	Sample(s) Affected	Analyte(s)	Validation Qualifier
F88938	CY0040	Aluminum, Arsenic, Barium, Beryllium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Vanadium, Zinc	J

3.2 Reporting Limits

Limits have been established to describe project sensitivity requirements. Each laboratory is required to demonstrate method performance through method detection limit (MDL) studies for every method employed. These studies are required to be laboratory-specific so that individual laboratory variables such as equipment brands, reagent suppliers, and chemist technique are factored into the performance study. MDLs are established using controlled matrices (i.e., DI water). Practical quantitation limits (PQL) or method quantitation limits (MQL), used for this project are those statistically determined by the laboratories. The analytical program executed for this project required the use of SW-846 methods, which specify the procedure for calculating the MDLs. The PQL/MQL calculation adjusts the limit by a predetermined mathematical factor for the analysis of actual environmental sample matrices (i.e. soil, groundwater, etc.). Method reporting limits (MRL) are based on the project action or decision levels.

These limits are generally defined as follows:

- ***MDL.*** The minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the concentration is greater than zero.

- ***MQL/PQL.*** The lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. It is set at the lowest standard used for the calibration curve.

- ***MRL.*** A threshold value below which the laboratory reports a result as non-detected. Ideally, the MRL will be established anywhere between the MDL and 1/2 the project action levels.

An MDL is the lower limit at which the laboratory can differentiate a measurement from background. The MDL is determined in accordance with the procedures in 40 CFR Part 136. If project action levels are near or below the MDL, it is unlikely the sensitivity of the method will be achievable. A compromise must be reached. The PQL/MQL is the lower limit at which a measurement becomes meaningful. This measurement (the PQL or the RL) is generally a multiple of three to five times the MDL.

Most samples were handled and analyzed as expected without significant changes to the anticipated project MQLs.

3.3 Holding Times/Preservation

All laboratory results submitted for this investigation have been reviewed with respect to laboratory adherence to extraction and analysis holding times. All hold times and preservation requirements were met. No qualification required.

4.0 Data Evaluation and Usability

The analytical data review process identified a few analytical nonconformance issues that were noted during this analytical program. These anomalies have been discussed in the previous sections of this appendix. Table 3 summarizes all compounds requiring qualifier application due to anomalies discovered during data validation. Table 4 defines the reason codes for qualification and Table 5 defines the data validation qualifiers.

The following definitions are used for defining precision, accuracy, representativeness, completeness, and comparability as they have been applied to this evaluation.

Precision. Precision is a measurement of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision data were obtained through the analysis and evaluation of duplicate QA samples. Accuracy was determined through the analysis and evaluation of method blanks, LCSs, trip blanks, equipment rinsates, and MS samples.

Accuracy. Accuracy is a measurement of bias in a system and is expressed as a percent recovery. These QA samples were collected and/or analyzed at the frequency established in the SAP, verifying the completeness element of the DQOs along with the evaluation of holding times and reporting limits. Percent recovery is calculated as follows:

$$Percent\ \mathrm{Re}\,\mathrm{cov}ery = \left(\frac{(x-s)}{T}\right) * 100$$

Where:

X = the lab determined concentration of a spiked sample
S = the sample native concentration prior to spike
T = the true concentration of the spike

Relative Percent Difference is calculated as follows:

$$\mathrm{Re}\,lative\ Percent\ Difference = \left[\frac{|D1 - D2|}{\frac{D1 + D2}{2}}\right] * 100$$

Where:

D1 and D2 = the results of duplicate measurements

Representativeness. Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix and site conditions. For example, in conducting ground water monitoring, representativeness requires proper location of wells and the collection of samples under consistent, documented procedures. Wells are located based upon the results of the hydrological study in progress and are designed to provide maximum coverage of the flow conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness also can be monitored by reviewing field documentation and by performing field audits.

The samples were collected using Shaw SOPs and were fully documented through the use of standard Shaw field forms. Samples are representative of the matrix and site sampled.

Completeness. Completeness is a measure of the amount of valid data that are obtained during a sampling event as compared to the amount of data planned to be collected under optimum conditions. Some data for this project were qualified as estimated in the validation

process because of the outliers noted in the MS recoveries, duplicate results for certain elements, and various other calibration and column confirmation percent difference results. Completeness is calculated as follows:

$$Completeness\ \% = \left(\frac{D_r}{D_c}\right) X\ 100$$

Where:

D_r = the number of data points for which valid results are reported

D_c = the number of valid samples/data points that are collected and reach the laboratory for analysis.

During this task, twelve regular project samples, one field duplicate and one field split sample were collected resulting in approximately 1809 targeted analytical records. No results were rejected. Using the above calculation, 100% completeness was achieved for the task.

Comparability. Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability ensures that results for the sampling event can be compared with data from other past and/or future sampling programs. Comparability for this sampling event was achieved through the use of established and recognized techniques and accepted standard EPA methods. All samples collected and analyzed were subjected to the same sampling, handling, preparation, analysis, reporting, and validation criteria for the purpose of achieving comparability goals within the data set.

4.1 Statement of Data Usability

The overall results of the analyses, as discussed in this evaluation, suggest that representative samples were collected and analyzed, and the results are indicative of the media analyzed, with the exception of the few anomalies noted. The data do reflect expected site conditions and are usable for their intended purpose.

Tables 1, 2, 3, 4 and 5 summarize the analytical program and the results for the data validation effort for all samples collected by Shaw at PBOW Coal Yard 3 area.

Table 1

Sample Cross-Reference
Former Plum Brook Ordnance Works
Sandusky, Ohio

Sample Type	Sample Location	Sample Number	Sample Date	Sample Purpose	SDG Number	Laboratory
SS	CY3-SB01	CY0031	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB01	CY0032	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB01	CY0033	19-Dec-11	FD	F88938	Accutest
DS	CY3-SB01	CY0034	19-Dec-11	FS	240-7168-1	Test America
DS	CY3-SB01	CY0035	19-Dec-11	REG	F88938	Accutest
SS	CY3-SB02	CY0036	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB02	CY0037	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB02	CY0038	19-Dec-11	REG	F88938	Accutest
SS	CY3-SB03	CY0039	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB03	CY0040	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB03	CY0041	19-Dec-11	REG	F88938	Accutest
SS	CY3-SB04	CY0042	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB04	CY0043	19-Dec-11	REG	F88938	Accutest
DS	CY3-SB04	CY0044	19-Dec-11	REG	F88938	Accutest

Table 2

Summary of Original, Field Duplicate, and Field Split Hits with Relative Percent Difference Calculations
Former Plum Brook Ordnance Works
Sandusky, Ohio

		Location:	CY3-SB01		CY3-SB01		CY3-SB01		Relative	Relative
		Sample Number:	CY0032		CY0033		CY0034		Percent	Percent
		Sample Date:	19-Dec-11		19-Dec-11		19-Dec-11		Difference	Difference
		Sample depth:	3 - 5 Ft		3 - 5 Ft		3 - 5 Ft		REG and FD	REG and FS
		Sample Purpose:	REG		FD		FS			
Parameter	Filtered	Units	Result	ValQual	Result	ValQual	Result	ValQual		
Aluminum	N	mg/kg	11400		11400		8700		0.00	26.87
Arsenic	N	mg/kg	8.7		12.9		4.2		38.89	69.77
Barium	N	mg/kg	64.3		70.7		61		9.48	5.27
Beryllium	N	mg/kg	0.7	J	0.61	J	0.18	J	13.74	118.18
Cadmium	N	mg/kg	0.96	U	1.2	U	0.054	J	-	-
Calcium	N	mg/kg	2740		3260		2700	J	17.33	1.47
Chromium	N	mg/kg	15.6		17.2		12	J	9.76	26.09
Cobalt	N	mg/kg	8.6	J	8.4	J	6		2.35	35.62
Copper	N	mg/kg	13.2		19.5		9.2	J	38.53	35.71
Iron	N	mg/kg	18700		25800		14000		31.91	28.75
Lead	N	mg/kg	8.6		9.7		5.7		12.02	40.56
Magnesium	N	mg/kg	2250		1970		2000		13.27	11.76
Manganese	N	mg/kg	426		291		230	J	37.66	59.76
Mercury	N	mg/kg	0.021	J	0.049	J	0.022	J	**80.00**	4.65
Nickel	N	mg/kg	19.6		23.9		13		19.77	40.49
Potassium	N	mg/kg	697	J	598	J	550	J	15.29	23.58
Thallium	N	mg/kg	0.48	U	0.62	U	1	J	-	-
Vanadium	N	mg/kg	27.3		33.4		19		20.10	35.85
Zinc	N	mg/kg	38.5		50.4		30	J	26.77	24.82

Table 3

Summary of Data Validation Reason Codes
Former Plum Brook Ordnance Works
Sandusky, Ohio

Reason Code	Description
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding Time Exceeded
02A	Extraction
02B	Analysis
03	Instrument Performance - Outside Criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	retention time windows
03E	Resolution
04	Initial Calibration results outside specified criteria
04A	Compound mean RRF<0.05
04B	Compound %RSD>30
04C	Correlation Coefficient<0.995
05	Continuing Calibration results outside specified criteria
05A	Compound mean RRF<0.05
05B	Compound %D>25
06	Result qualified as a result of the 5x/10x blank correction
06A	Method or Preparation Blank
06B	ICB or CCB
06C	ER
06D	TB
06E	FB
07	Surrogate Recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	%RPD outside acceptance criteria (precision)
09	Post Digestion Spike outside criteria (GFAA)
10	Internal Standards outside specified control limits
10A	Recovery
10B	Retention Time
11	Laboratory Control Sample recoveries outside specified control limits
11A	Recovery
11B	%RPD (if run in duplicate)
12	Interference Check Standard
13	Serial Dilution
14	Tentatively Identified Compounds
15	Quantitation
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria exceeded
18	Percent difference between original and second column > 25%
19	Professional judgement was used to qualify the data
20	Pesticide clean-up checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantitation
24	Reported result and/or lab qualifier revised to reflect validation findings
999	See hard copy for details.

Table 4

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

Work Order	Sample Number	Analysis	Parameter	Reason Codes				
				VQ	R1	R2	R3	R4
F88938	CY0031	METALS3	Potassium	J	15			
F88938	CY0031	METALS3	Beryllium	J	15			
F88938	CY0031	METALS3	Cadmium	J	15			
F88938	CY0031	METALS3	Mercury	J	15			
F88938	CY0031	SEMIVOLATILES3	Anthracene	J	15			
F88938	CY0031	SEMIVOLATILES3	Benzo(k)fluoranthene	J	15			
F88938	CY0031	SEMIVOLATILES3	Acenaphthylene	J	15			
F88938	CY0031	SEMIVOLATILES3	Dibenz(a,h)anthracene	J	15			
F88938	CY0032	METALS3	Potassium	J	15			
F88938	CY0032	METALS3	Beryllium	J	15			
F88938	CY0032	METALS3	Cobalt	J	15			
F88938	CY0032	METALS3	Mercury	J	15	17		
F88938	CY0033	METALS3	Potassium	J	15			
F88938	CY0033	METALS3	Beryllium	J	15			
F88938	CY0033	METALS3	Cobalt	J	15			
F88938	CY0033	METALS3	Mercury	J	15	17		
240-7168-1	CY0034	METALS3	Manganese	J	08A			
240-7168-1	CY0034	METALS3	Potassium	J	15			
240-7168-1	CY0034	METALS3	Thallium	J	15			
240-7168-1	CY0034	METALS3	Antimony	UJ	08A			
240-7168-1	CY0034	METALS3	Beryllium	J	15			
240-7168-1	CY0034	METALS3	Cadmium	J	15			
240-7168-1	CY0034	METALS3	Chromium	J	08A			
240-7168-1	CY0034	METALS3	Copper	J	08A			
240-7168-1	CY0034	METALS3	Zinc	J	08A			
240-7168-1	CY0034	METALS3	Calcium	J	08A			
240-7168-1	CY0034	METALS3	Mercury	J	15			
F88938	CY0035	METALS3	Sodium	J	15			
F88938	CY0035	METALS3	Cadmium	J	15			
F88938	CY0035	METALS3	Mercury	J	15			
F88938	CY0036	METALS3	Potassium	J	15			
F88938	CY0036	METALS3	Sodium	J	15			
F88938	CY0036	METALS3	Beryllium	J	15			
F88938	CY0036	METALS3	Mercury	J	15			
F88938	CY0036	SEMIVOLATILES3	Anthracene	J	15			
F88938	CY0036	SEMIVOLATILES3	Benzo(k)fluoranthene	J	15			
F88938	CY0036	SEMIVOLATILES3	Acenaphthylene	J	15			
F88938	CY0036	SEMIVOLATILES3	Dibenz(a,h)anthracene	J	15			
F88938	CY0037	METALS3	Potassium	J	15			
F88938	CY0037	METALS3	Mercury	J	15			
F88938	CY0038	METALS3	Potassium	J	15			
F88938	CY0038	METALS3	Sodium	J	15			
F88938	CY0038	METALS3	Antimony	J	15			

Table 4

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

Work Order	Sample Number	Analysis	Parameter	Reason Codes				
				VQ	R1	R2	R3	R4
F88938	CY0038	METALS3	Mercury	J	15			
F88938	CY0039	METALS3	Sodium	J	15			
F88938	CY0039	METALS3	Cadmium	J	15			
F88938	CY0039	METALS3	Mercury	J	15			
F88938	CY0039	SEMIVOLATILES3	Pyrene	J	15			
F88938	CY0039	SEMIVOLATILES3	Benzo(ghi)perylene	J	15			
F88938	CY0039	SEMIVOLATILES3	Indeno(1,2,3-cd)pyrene	J	15			
F88938	CY0039	SEMIVOLATILES3	Benzo(b)fluoranthene	J	15			
F88938	CY0039	SEMIVOLATILES3	Fluoranthene	J	15			
F88938	CY0039	SEMIVOLATILES3	Benzo(k)fluoranthene	J	15			
F88938	CY0039	SEMIVOLATILES3	Chrysene	J	15			
F88938	CY0039	SEMIVOLATILES3	Benzo(a)pyrene	J	15			
F88938	CY0039	SEMIVOLATILES3	Benzo(a)anthracene	J	15			
F88938	CY0039	SEMIVOLATILES3	Phenanthrene	J	15			
F88938	CY0039	SEMIVOLATILES3	Methylnaphthalene, 2-	J	15			
F88938	CY0040	METALS3	Aluminum	J	13			
F88938	CY0040	METALS3	Iron	J	13			
F88938	CY0040	METALS3	Lead	J	13			
F88938	CY0040	METALS3	Magnesium	J	08A	13		
F88938	CY0040	METALS3	Manganese	J	08B	13		
F88938	CY0040	METALS3	Nickel	J	08A	13		
F88938	CY0040	METALS3	Potassium	J	08A	15	13	
F88938	CY0040	METALS3	Sodium	UJ	08A			
F88938	CY0040	METALS3	Antimony	UJ	08A			
F88938	CY0040	METALS3	Arsenic	J	08A	13		
F88938	CY0040	METALS3	Barium	J	08A	13		
F88938	CY0040	METALS3	Beryllium	J	08A	13		
F88938	CY0040	METALS3	Cadmium	J	08A			
F88938	CY0040	METALS3	Chromium	J	08A	13		
F88938	CY0040	METALS3	Cobalt	J	08A	13		
F88938	CY0040	METALS3	Copper	J	08A	13		
F88938	CY0040	METALS3	Vanadium	J	08A	13		
F88938	CY0040	METALS3	Zinc	J	08A	13		
F88938	CY0040	METALS3	Calcium	J	08A	08B	13	
F88938	CY0040	METALS3	Silver	UJ	08A			
F88938	CY0040	METALS3	Selenium	UJ	08A			
F88938	CY0040	METALS3	Mercury	J	15			
F88938	CY0040	SEMIVOLATILES3	Benzoic acid	UJ	08A			
F88938	CY0040	SEMIVOLATILES3	Isophorone	UJ	08A			
F88938	CY0041	METALS3	Sodium	J	15			
F88938	CY0041	METALS3	Antimony	J	15			
F88938	CY0041	METALS3	Mercury	J	15			
F88938	CY0042	METALS3	Sodium	J	15			

Table 4

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

Work Order	Sample Number	Analysis	Parameter	Reason Codes				
				VQ	R1	R2	R3	R4
F88938	CY0042	METALS3	Cadmium	J	15			
F88938	CY0042	METALS3	Mercury	J	15			
F88938	CY0043	METALS3	Potassium	J	15			
F88938	CY0043	METALS3	Beryllium	J	15			
F88938	CY0043	METALS3	Mercury	J	15			
F88938	CY0044	METALS3	Sodium	J	15			
F88938	CY0044	METALS3	Cadmium	J	15			
F88938	CY0044	METALS3	Mercury	J	15			

Table 5

Laboratory and Validation Qualifier Definitions
Former Plum Brook Ordnance Works
Sandusky, Ohio

Qualifier	Definition
Laboratory	
B	Indicates the analyte is found in associated method blank.
J	Indicates the analyte result is an estimated value.
ND	Not detected. The compound was analyzed for, but not detected above the associated reporting limit.
MDL	Method detection limit.
RL	Reporting limit.
E	Indicates the value exceeds the calibration range.
ND	Indicates presumptive evidence of a compound

Validation	
B	The compound/analyte was detected in a lab or field blank.
J	The compound/analyte was positively identified; the reported value is an estimated concentration.
U	Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.
UJ	The analyte is not detected; the result is an estimated value.
R	Analyte is rejected.

DATA QUALITY EVALUATION

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List of Acronyms

AR/COC	analysis request/chain of custody
CCAL	continuing calibration
CFR	Code of Federal Regulations
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
GC/MS	gas chromatography/mass spectrometry
ICAL	initial calibration
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
LCS	laboratory control sample
MDL	method detection limit
MQL	method quantitation limit
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
PBOW	Plum Brook Ordnance Works
PQL	practical quanitation limit
QA/QC	quality assurance/quality control
RL	reporting limit
RPD	relative percent difference
SAP	sampling analysis plan
SDG	sample delivery group
Shaw	Shaw Environmental, Inc.
SOP	standard operating procedures

1.0 Introduction

This appendix presents results of the quality assurance/quality control (QA/QC) measures implemented for the sampling and analysis activities at Ash Pit 3 at Plum Brook Ordnance Works (PBOW), Sandusky, Ohio. The quality indicators from every aspect of the data collection were reviewed, and an assessment of the data with regard to project-specific objectives is presented. Successful execution of project-specific objectives and procedures provides strong support for the acceptance of the data generated as adequate for the purpose of evaluating the analytical results from Ash Pit 3 at PBOW.

Shaw Environmental, Inc. (Shaw) conducted investigative sampling at Ash Pit 3 August 2009 through May 2012. Primary and field duplicate project samples were analyzed by Accutest Laboratories, of Orlando, Florida. Field Split samples were submitted to Test America Laboratories, Inc. of North Canton, Ohio for analysis. All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed were validated following the logic identified in the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review (October 2004) and the EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Review (June 2008) for all areas except blanks. EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (April 1993) and Region III Modifications to National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration (September 1994) were applied to the areas associated with blank contamination. Specific quality control QC criteria as identified in the quality assurance plan QAP, analytical methods, and laboratory standard operating procedures (SOP) were applied to all sample results. As a result of the use of Update III SW846 test methods for the analytical data and the application of the CLP guidelines during the validation process, there were instances where the specific QC requirements for all target compounds were not defined. This primarily occurred in the organic, gas chromatography/mass spectrometry (GC/MS) calibration areas and is due to the fact that the analytical methods are performance-based and allow the use of average calibration responses in lieu of individual responses, which are defined by CLP protocol. In light of applying CLP guidelines to SW846 methods and evaluating the usability of the data during the validation process, specific QC criteria were determined to address all target compounds and are identified in this report for each parameter, as well as in the validation checklists, which function as worksheets. For those analytical methods not addressed by the CLP and Region III guidelines, the validation was based on the method requirements (i.e., SW846, Code of Federal

Regulations [CFR], SOPs), DoD QSM 4.2, and technical judgment, following the logic of the CLP validation guidelines.

These data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness and comparability goals established to meet the project data quality objectives (DQO). To verify that these DQOs were met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and all nonconformances and discrepancies in the data were examined to determine compliance with the appropriate and applicable procedures defined in the sampling analysis plan (SAP). The results of this review are presented in the following sections, with all analytical outliers or nonconformances discussed where they occurred.

This report is divided into three subsections. Section 2.0 discusses the field investigation and QC procedures used during the sampling effort. Section 3.0 outlines the analytical program and the associated QC activities performed. The final part of this document, Section 4.0, summarizes the data findings and their overall impact on the usability of the analytical data.

2.0 Field Sampling and QC Activities

Shaw was retained by the U. S. Army Corps of Engineers, Nashville District to conduct investigative and sampling activities at PBOW Ash Pit 3. Field activities at this site included collection of surface soil samples, subsurface soil samples, sediment samples, surface water samples and groundwater samples. The collection of these samples and their associated QC samples are discussed in this section of the Data Quality Evaluation. Six project and one field duplicate groundwater samples were submitted to Accutest, Orlando, Florida for analysis. One field split groundwater sample was submitted to Test America, North Canton, Ohio for analysis. Sample shipments from the field were performed under custody and documented using standard Shaw Analysis Request/Chain of Custody (AR/COC) forms. These forms provided project-specific analytical specifications and QC instructions to the laboratory. A formal COC transfer record was prepared and included with these forms to document custody during sample transportation, storage, and disposition by the laboratory. Table 1 summarizes the field sample number, location, sample type, date of collection, lot number, and laboratory for each sample collected.

2.1 Equipment Rinsates

Equipment rinsates are used to assess the effectiveness of the decontamination procedures used by the sampling team on reusable sampling equipment. No equipment rinsate samples were collected during this sampling event.

2.2 Field Duplicates

Field duplicate samples are collected and submitted to the laboratory for analysis along with their corresponding original sample. The data generated from the analysis of field duplicate samples are used to evaluate the precision of the sample collection and analysis procedures. It is difficult to collect and analyze soil samples in duplicate due to the heterogeneous nature of soil. High relative percent difference (RPD) between an original sample and its field duplicate may indicate a difference in sample matrix or sample collection rather than true problems with precision of sample analysis. Also, when estimated "J" or non-detected "U" results are reported, there is a potential for increased variability between the primary and duplicate sample results.

Field duplicate samples were collected at a frequency of one for every ten samples (10 percent) or one per sampling event when fewer than 10 samples were collected. One field duplicate water sample was collected during this sampling event. Table 2 compares the original and field duplicate results and shows the RPDs calculated for those detected compounds. Compounds not presented in the table were not detected in either the original or field duplicate samples. Sample sets with no detections are not presented in the table. In cases where duplicates were performed and one result is less than the reporting limit (RL) but greater than the method detection limit (MDL), the RPD is reported, but is of limited value. Only samples with detections in both the regular and the duplicate were qualified for high RPDs.

The acceptance criterion of 30 percent RPD for waters and 50 percent RPD for soils was used to evaluate these sample results. The data compared well when detected concentrations were greater than the RL. RPD is calculated by using the following formula:

$$RPD = \left| \frac{A - B}{(A + B)/2} \right| \quad x \quad 100$$

where:

RPD = relative percent difference
A = original result

B = field duplicate result.

2.3 Field Split Samples

Split samples were collected in conjunction with field duplicate samples and sent to Test America Laboratories, Inc. of North Canton, Ohio. The split samples were submitted to the laboratory for the same analysis as their corresponding field duplicates and original field samples. The split samples are used to determine if data results are reproducible when analyzed by two different laboratories. Results are also evaluated to determine if a contracted laboratory's preparation and analysis procedures are in control and meet the approved method criteria.

Field split samples were collected at a frequency of approximately one for every ten regular samples or one per sampling event when fewer than ten samples were collected. One groundwater field split sample was collected during this sampling event. Table 2 compares the original and field split results and shows the RPDs calculated for those detected compounds. Compounds not presented in the table were not detected in either the original or field split samples. Samples with no detections are not presented in the table. Field split samples were not qualified for RPD criterion.

3.0 Analytical Program and QC Activities

The project QA/QC program described in the SAP was followed for the collection and laboratory analysis of samples. Each of the analytical methods used require that method-specific QA/QC protocols be followed during sample analysis. These protocols are a critical part of the methods employed and were followed by the laboratory during sample analysis. Specific measures included detailed record keeping procedures, instrument calibrations, and analysis of method blanks, blank spikes, matrix spike/matrix spike duplicate MS/MSD, surrogates, and internal standards. The following SW-846 and EPA methods were used to analyze PBOW samples:

Analysis	Method
Volatile Organics	SW846 5030/8260B
Polychlorinated Biphenyls	SW846 3510C/8082
Semivolatile Organics	SW846 3510C/8270D
Total and Dissolved Metals	SW846 3005A/6010C/7470A
Nitroaromatic and Nitramine Explosives	SW846 3535A/8330A

Analysis	Method
Wet Chemistry	TOC, Sulfate, Nitrate, Chloride, Alkalinity, Turbidity, TDS, TSS, Hardness, Cyanide

The validator used the QA/QC criteria defined in the SAP, laboratory-derived acceptance criteria, and analytical method criteria to qualify data. Any qualifiers added to these data by the data validator are included in the data summary report.

3.1 Laboratory QA/QC Procedures

The following sections discuss specific QA/QC protocols required and performed by the laboratory during this investigation.

3.1.1 Calibration

The calibration of instruments is required to ensure that the instruments are operating properly. Calibration is achieved when instrument response can be related to the concentration of an analyte. All initial calibration (ICAL) individual relative response factor criteria were met.

Individual ICAL percent relative standard deviation and/or continuing calibration (CCAL) percent difference criteria were met for all fractions. The criteria used to evaluate the data are: individual ICAL percent relative standard deviation <+/- 30% and/or CCAL percent difference <+/- 20% (volatile and semivolatile organics); <+/-15% (explosives); for metals, individual ICAL/CCAL percent relative standard deviation <+/- 10%; and for mercury, individual ICAL/CCAL percent relative standard deviation <+/- 20%.

The following exhibited individual ICAL percent relative standard deviation > +/- 30% and/or CCAL percent difference > +/-20%:

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
F93578	AP3088, AP3091, AP3092	Carbon tetrachloride	UJ
	AP3088	Chloromethane	
	AP3091, AP3092	Methylene chloride	

3.1.2 Method/Calibration Blanks

Method blanks are analyzed with each analytical "batch" processed on a per matrix (i.e., soil and water) basis. Method blanks are carried step-wise through the same analytical procedure as their associated field samples including the addition of solvents, surrogate and standard spikes, and

reagents as required in the analysis process. The purpose of a method blank is to identify any contaminants that may be introduced to the sample as a result of the analytical process. The method blank is considered acceptable by the laboratory if the concentration of any target analyte is less than ½ the reporting limit and less than 1/10 the amount measure in any sample or regulatory limit (whichever is greater). The data validator evaluated all blank data associated with each sample. The data validators evaluated all blank data associated with each sample. The third party data validation evaluation criteria for method blanks are as follows:

- If a parameter is found in a blank but not detected in the sample, no action is taken.
- For organics, if the sample result is less than 5 times (most analytes) or 10 times (common laboratory contaminants) that of the blank result, the sample result is qualified “B.”
- For inorganics, if the sample result is greater than the instrument detection limit but less than 5 times the blank result, the sample result is qualified "B."

If the sample result is greater than 5 times (most analytes) or 10 times (common laboratory contaminants) the blank result, no action is taken.

All method blanks were found to be acceptable with the following exceptions:

SDG Number	Samples Affected	Analyte(s)	Blank Contaminant	Validation Qualifier
240-7113-1	AP3085	Bis(2-ethylhexyl)phthalate	Method	
		Nitrate-Nitrite		

3.1.3 Surrogate Recoveries

Surrogate standards are defined as non-target compounds added to standards, blanks, and samples prior to extraction or purging. They are used in organic analyses to monitor the percent recovery efficiencies of the sample preparation and analytical procedures. Surrogate recoveries for the project samples all fell within acceptable QC criteria with the exception noted below for the field split sample.

SDG Number	Samples Affected	Analytes	Validation Qualifier

SDG Number	Samples Affected	Analytes	Validation Qualifier
240-7113-1	AP3085	2-Nitrophenol, 4,6-Dinitro-2-methylphenol, 2,4-Dinitrophenol, 2,4-Dimethylphenol, 2,4,5-Trichlorophenol, 2-Methylphenol, 2,4,6-Trichlorophenol, Pentachlorophenol, 2,4-Dichlorophenol, Phenol, 2-Chlorophenol, 3-Methylphenol & 4-Methylphenol, 4-Nitrophenol, 4-Chloro-3-methylphenol	UJ/J

The surrogate control limits for this project can be found in Attachment A of Appendix E. The surrogate control limits used for evaluation are the laboratory established in-house surrogate criteria.

3.1.4 Matrix Spikes and Laboratory Control Spikes

Two types of spikes were performed for all analyses: matrix spikes (MS) and laboratory control samples (LCS). MS compounds are spiked into an aliquot of a field sample. LCS compounds are spiked into a blank matrix. The spiked compounds are representative compounds that are quantified during performance of the method. Recovery of the spiked compound is used as an assessment of analytical accuracy for the sample matrix analyzed. These results are useful in distinguishing sample matrix interferences from analysis interferences through a comparison of MS and LCS recovery data. Often, spikes are performed in duplicate as a MSD or LCS duplicate. In this manner, the precision of the assessment can be quantified as the RPD of the original and duplicate spike.

Matrix spikes were assigned at a frequency of at least 1 for every 20 field samples collected. Two MS/MSD pairs AP3085-MS/MSD and AP3086-MS/MSD, were assigned to samples. Additional sample volume was provided to the laboratory for the MS/MSD analyses. This sampling frequency meets the collection criteria for this program as specified in the SAP. In addition to the overall collection frequency, the analytical method requires that the laboratory analyze 1 set of spikes per analytical batch. To comply with this method requirement, the laboratory may analyze additional MS/MSD pairs. The validator evaluated all batch QC. The laboratory's statistically determined target acceptance limits were used to assess the spike recovery and RPD. The following MS/MSD recoveries are outside of established QC criteria:

Volatile Analysis:

SDG Number	Samples Affected	Compound(s)	Validation Qualifier

F88782	AP3086	cis-1,3-Dichloropropene, Acetone, Bromoform, Styrene trans-1,3-Dichloropropene,	UJ

Wet Chemistry Analysis:

SDG Number	Samples Affected	Analytes(s)	Validation Qualifier
F88900	AP3083, AP3084	Sulfate	J

LCS results are used to evaluate lab method performance in the same manner as the MS/MSD results except the LCS is not performed on an actual field sample matrix. The LCS is prepared for each analytical batch and for each parameter and matrix analyzed. The LCS recoveries met established QC criteria for the project samples.

The LCS and MS/MSD control limits for this project can be found in Attachment A of Appendix E. The LCS and MS/MSD control used for evaluation are the laboratory established in-house control limits. Detected constituents with associated MS/MSD or LCS recoveries above or below the QC limits were qualified as estimated “J”. Sample results with associated MS/MSD or LCS recoveries below the QC limits were qualified as estimated non-detects “UJ”.

3.1.5 Laboratory Duplicate Sample Analysis

Laboratory Duplicate determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate sample analyses are also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. Laboratory duplicates are not required for polychlorinated biphenyl analysis. No laboratory duplicates were assigned.

3.1.6 Column Agreement

For GC analyses, sample results are confirmed using two dissimilar columns. In order for an analyte to be reported, it must be detected on both columns. Results differing by greater than 40 percent are qualified estimated, "J".

All detections were in agreement with the exception of the following:

SDG	Samples Affected	Analyte(s)	Validation Qualifier
F93578	AP3088	2-Nitrotoluene	J

3.1.7 Interference Check Sample and Post Digestion Spike

The ICP Interference Check Sample (ICS) verifies the contract laboratory's interelement and background correction factors. The ICS consists of two solutions: Solution A and Solution AB. Solution A consists of the interferents, and solution AB consists of the analytes mixed with the interferents. An ICS analysis consists of analyzing both solutions consecutively, starting with solution A, for all wavelengths used for each analyte reported by ICP. Results for the ICP analysis of the ICS solution AB must fall within the control limits of ± 20% of the true value for the analytes included in the solution. All Interference Check Sample (ICS) percent recoveries were acceptable with the following exceptions:

SDG Number	Samples Affected	Analyte(s)	Validation Qualifier
F88782	AP3086	Ba, Mg, Ca	J
F88900	AP3083, AP3084, AP3087	Ba, Mg, Ca, Fe	J/UJ

Post Digestion spikes are elements added to a portion of a prepared sample to verify the absence or presence of matrix effects for ICP and ICP/MS analysis. To verify the absence of interference, the spike recovery must be between 75% and 125%. Results outside the acceptance limits require a method of standard additions (MSA) for all samples within the batch. All post digestion spike recoveries were found to be acceptable.

3.1.8 Inductively Coupled Plasma Serial Dilutions

The ICP serial dilution analysis is performed to determine whether or not significant physical or chemical interferences exist due to sample matrix. All QC criteria were met for the serial dilutions associated with the project samples, with the following exceptions:

SDG	Samples Affected	Analytes(s)	Validation Qualifier
F65474	AP1009	(Total) Mn, Ca, Co, Fe, Mg, Ni, Zn	J
F67482	AP0032, AP0033, AP0036, AP0037, AP0039, AP0040	(Total) Ca, Mn, Cr, Co, Fe, Mg, K	J

3.2 Reporting Limits

Limits have been established to describe project sensitivity requirements. Each laboratory is required to demonstrate method performance through MDL studies for every method employed.

These studies are required to be laboratory-specific so that individual laboratory variables such as equipment brands, reagent suppliers, and chemist technique are factored into the performance study. MDLs are established using controlled matrices (i.e., deionized water). Practical quantitation limits (PQL) or method quantitation limits (MQL), used for this project are those statistically determined by the laboratories. The analytical program executed for this project required the use of SW-846 methods, which specify the procedure for calculating the MDLs. The PQL/MQL calculation adjusts the limit by a predetermined mathematical factor for the analysis of actual environmental sample matrices (i.e. soil, groundwater, etc.). Method reporting limits (MRL) are based on the project action or decision levels.

These limits are generally defined as follows:

- ***MDL.*** The minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the concentration is greater than zero.
- ***MQL/PQL.*** The lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. It is set at the lowest standard used for the calibration curve.
- ***MRL.*** A threshold value below which the laboratory reports a result as non-detected. Ideally, the MRL will be established anywhere between the MDL and 1/2 the project action levels.

An MDL is the lower limit at which the laboratory can differentiate a measurement from background. The MDL is determined in accordance with the procedures in 40 CFR Part 136. If project action levels are near or below the MDL, it is unlikely the sensitivity of the method will be achievable. A compromise must be reached. The PQL/MQL is the lower limit at which a measurement becomes meaningful. This measurement (the PQL or the RL) is generally a multiple of three to five times the MDL. All samples were handled and analyzed as expected without significant changes to the anticipated project MQLs.

Reporting limits for the May 2012 sampling are elevated due to the use of snap samplers. An active bald eagle nest is present near the Ash pit 3 Monitoring Wells. The Ash Pit 3 wells were sampled with snap samplers to minimize disturbance to the nesting pair during the spring sample collection period. The snap samplers did not provide sufficient volume to analyze a full suite of constituents or a full volume sample for the analyses performed. Volatiles, explosives, and unfiltered metals analysis was performed on the water obtained from snap samplers. Re[porting limits for explosives are elevated due to insufficient volume to run the analysis at full volume.

Approximately 500 mL of sample was available for analysis of explosives from the snap samplers. Therefore, the LOD and LOQ for the May 2012 samples is approximately double that of the December 2011 event. A full discussion of the snap samplers can be found in Section 3.2 of the Site Characterization Report.

3.3 Holding Times/Preservation

All laboratory results submitted for this investigation have been reviewed with respect to laboratory adherence to extraction and analysis holding times. All hold times and preservation requirements were met with the following exception:

SDG Number	Samples Affected	Analysis	Validation Qualifier
F88900	AP3083, AP3084, AP3087	Alkalinity (Carbonate)	J

4.0 Data Evaluation and Usability

The analytical data review process identified a few analytical nonconformance issues that were noted during this analytical program. These anomalies have been discussed in the previous sections of this appendix. Table 3 summarizes all compounds requiring qualifier application due to anomalies discovered during data validation. Table 4 defines the reason codes for qualification and Table 5 defines the data validation qualifiers.

The following definitions are used for defining precision, accuracy, representativeness, completeness, and comparability as they have been applied to this evaluation.

Precision. Precision is a measurement of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision data were obtained through the analysis and evaluation of duplicate QA samples. Accuracy was determined through the analysis and evaluation of method blanks, LCSs, trip blanks, equipment rinsates, and MS samples.

Accuracy. Accuracy is a measurement of bias in a system and is expressed as a percent recovery. These QA samples were collected and/or analyzed at the frequency established in the SAP, verifying the completeness element of the DQOs along with the evaluation of holding times and reporting limits. Percent recovery is calculated as follows:

$$Percent\ \mathrm{Re}\,\mathrm{cov}ery = \left(\frac{(x-s)}{T}\right) * 100$$

Where:

X = the lab determined concentration of a spiked sample
S = the sample native concentration prior to spike
T = the true concentration of the spike

RPD is calculated as follows:

$$\mathrm{Re}\,lative\ Percent\ Difference = \left[\frac{|D1 - D2|}{\frac{D1 + D2}{2}}\right] * 100$$

Where:

D1 and D2 = the results of duplicate measurements

Representativeness. Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix and site conditions. For example, in conducting groundwater monitoring, representativeness requires proper location of wells and the collection of samples under consistent, documented procedures. Wells are located based upon the results of the hydrological study in progress and are designed to provide maximum coverage of the flow conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness also can be monitored by reviewing field documentation and by performing field audits.

The samples were collected using Shaw SOPs and were fully documented through the use of standard Shaw field forms. Samples are representative of the matrix and site sampled.

Completeness. Completeness is a measure of the amount of valid data that are obtained during a sampling event as compared to the amount of data planned to be collected under optimum conditions. Some data for this project were qualified as estimated in the validation process because of the outliers noted in the MS recoveries, duplicate results for certain elements, and various other calibration and column confirmation percent difference results. Completeness is calculated as follows:

$$Completeness\ \% = \left(\frac{D_r}{D_c}\right) X\ 100$$

Where:

D_r = the number of data points for which valid results are reported
D_c = the number of valid samples/data points that are collected and reach the laboratory for analysis.

During this task, six regular project samples, one field duplicate and one field split samples were collected resulting in approximately 1,176 targeted analytical records. Usable results were recorded for all samples. Using the above calculation, 100% completeness was achieved for the task.

Comparability. Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability ensures that results for the sampling event can be compared with data from other past and/or future sampling programs. Comparability for this sampling event was achieved through the use of established and recognized techniques and accepted standard EPA methods. All samples collected and analyzed were subjected to the same sampling, handling, preparation, analysis, reporting, and validation criteria for the purpose of achieving comparability goals within the data set.

4.1 Statement of Data Usability

The overall results of the analyses, as discussed in this evaluation, suggest that representative samples were collected and analyzed, and the results are indicative of the media analyzed, with the exception of the few anomalies noted. The data do reflect expected site conditions and are usable for their intended purpose.

Tables 1, 2, 3, 4 and 5 summarize the analytical program and the results for the data validation effort for all samples collected by Shaw at PBOW for the Ash Pit 3 location.

Table 1

Sample Cross-reference
Former Plum Brook Ordnance Works
Sandusky, Ohio

Sample Type	Sample Location	Sample Number	Sample Date	Sample Purpose	Sample Delivery Group	Laboratory
GW	AP3-MW01	AP3083	19-Dec-11	REG	F88900	Accutest
GW	AP3-MW01	AP3084	19-Dec-11	FD	F88900	Accutest
GW	AP3-MW01	AP3085	19-Dec-11	FS	240-7113-1	Test America
GW	AP3-MW01	AP3085-MS	19-Dec-11	MS	240-7113-1	Test America
GW	AP3-MW01	AP3085-MSD	19-Dec-11	MSD	240-7113-1	Test America
GW	AP3-MW02	AP3086	16-Dec-11	REG	F88782	Accutest
GW	AP3-MW02	AP3086-MS	16-Dec-11	MS	F88782	Accutest
GW	AP3-MW02	AP3086-MSD	16-Dec-11	MSD	F88782	Accutest
GW	AP3-MW03	AP3087	20-Dec-11	REG	F88900	Accutest
GW	AP3-MW01	AP3088	30-May-12	REG	F93578	Accutest
GW	AP3-MW02	AP3091	30-May-12	REG	F93578	Accutest
GW	AP3-MW03	AP3092	30-May-12	REG	F93578	Accutest

Table 2

Summary of Original, Field Duplicate, and Field Split Hits with Relative Percent Difference Calculations
Former Plum Brook Ordnance Works
Sandusky, Ohio

		Location:	AP3-MW01		AP3-MW01		AP3-MW01			
		Sample Number:	AP3083		AP3084		AP3085			
		Sample Date:	19-Dec-11		19-Dec-11		19-Dec-11		Relative	Relative
		Sample Depth:	1.3 - 1.3 Ft		1.3 - 1.3 Ft		1.3 - 1.3 Ft		Percent	Percent
		Matrix:	GW		GW		GW		Difference	Difference
		Sample Purpose:	REG		FD		FS		REG and FD	REG and FS
Parameter	Filtered	Units	Result	ValQual	Result	ValQual	Result	ValQual		
Barium	N	ug/L	40.6	J	39.5	J	45	J	2.75	10.28
Calcium	N	ug/L	117000	J	121000	J	130000		3.36	10.53
Cobalt	N	ug/L	1.2	J	1.1	J	1.7	J	8.70	34.48
Iron	N	ug/L	57.5	J	70.6	J	130	J	20.45	77.33
Magnesium	N	ug/L	25900	J	27700	J	29000		6.72	11.29
Manganese	N	ug/L	1760		1780		1900		1.13	7.65
Potassium	N	ug/L	805	J	716	J	900	J	11.70	11.14
Sodium	N	ug/L	20100		19500		20000		3.03	0.50
Barium	Y	ug/L	40.5	J	43.5	J	46	J	7.14	12.72
Calcium	Y	ug/L	119000		125000		130000		4.92	8.84
Cobalt	Y	ug/L	1.4	J	1.3	J	7	U	7.41	-
Copper	Y	ug/L	7.3	J	25	U	25	U	-	-
Iron	Y	ug/L	74.1	J	67.4	J	81	J	9.47	8.90
Magnesium	Y	ug/L	27400		29000		29000		5.67	5.67
Manganese	Y	ug/L	1720		1800		1900		4.55	9.94
Potassium	Y	ug/L	744	J	766	J	860	J	2.91	14.46
Sodium	Y	ug/L	19800		21300		19000		7.30	4.12
Chloride	N	mg/L	1.8	J	1.7	J	1.7		5.71	5.71
Hardness (as CaCO3)	N	mg/L	399		416		470		4.17	16.34
Sulfate	N	mg/L	162	J	167	J	180		3.04	10.53
Total dissolved solids	N	mg/L	557	J	398	J	530		**33.30**	4.97
Dichloroethane, 1,1-	N	ug/L	1.7		1.6		1.3		6.06	26.67
Trichloroethane, 1,1,1-	N	ug/L	0.27	J	0.26	J	1	U	3.77	-

"-" = Not Calculated
Notdetects reported at LOD.

Table 3

Summary of Data Validation Reason Codes
Former Plum Brook Ordnance Works
Sandusky, Ohio

Reason Code	Description
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding Time Exceeded
02A	Extraction
02B	Analysis
03	Instrument Performance - Outside Criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	retention time windows
03E	Resolution
04	Initial Calibration results outside specified criteria
04A	Compound mean RRF<0.05
04B	Compound %RSD>30
04C	Correlation Coefficient<0.995
05	Continuing Calibration results outside specified criteria
05A	Compound mean RRF<0.05
05B	Compound %D>25
06	Result qualified as a result of the 5x/10x blank correction
06A	Method or Preparation Blank
06B	ICB or CCB
06C	ER
06D	TB
06E	FB
07	Surrogate Recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	%RPD outside acceptance criteria (precision)
09	Post Digestion Spike outside criteria (GFAA)
10	Internal Standards outside specified control limits
10A	Recovery
10B	Retention Time
11	Laboratory Control Sample recoveries outside specified control limits
11A	Recovery
11B	%RPD (if run in duplicate)
12	Interference Check Standard
13	Serial Dilution
14	Tentatively Identified Compounds
15	Quantitation
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria exceeded
18	Percent difference between original and second column > 25%
19	Professional judgement was used to qualify the data
20	Pesticide clean-up checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantitation
24	Reported result and/or lab qualifier revised to reflect validation findings
999	See hard copy for details.

Table 4

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

SDG	Sample Number	Analysis	Parameter	VQ	Reason Codes R1	R2	R3	R4
240-7113-1	AP3085	ALKALINITY	Alkalinity	R	16			
240-7113-1	AP3085	METALS3-W	Barium	J	15			
240-7113-1	AP3085	METALS3-W	Barium	J	15			
240-7113-1	AP3085	METALS3-W	Cobalt	J	15			
240-7113-1	AP3085	METALS3-W	Arsenic	J	15			
240-7113-1	AP3085	METALS3-W	Iron	J	15			
240-7113-1	AP3085	METALS3-W	Iron	J	15			
240-7113-1	AP3085	METALS3-W	Potassium	J	15			
240-7113-1	AP3085	METALS3-W	Potassium	J	15			
240-7113-1	AP3085	NO2/NO3	Nitrate-Nitrite	B	06A	15		
240-7113-1	AP3085	SEMIVOLATILES	Nitrophenol, 2-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Dinitro-2-methylphenol, 4,6-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Dinitrophenol, 2,4-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Dimethylphenol, 2,4-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Trichlorophenol, 2,4,5-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Methylphenol, 2-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Trichlorophenol, 2,4,6-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Pentachlorophenol	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Bis(2-ethylhexyl)phthalate	B	06A	15		
240-7113-1	AP3085	SEMIVOLATILES	Dichlorophenol, 2,4-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Phenol	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Chlorophenol, 2-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	3-Methylphenol and 4-Methylphenol	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Nitrophenol, 4-	UJ	07A			
240-7113-1	AP3085	SEMIVOLATILES	Chloro-3-methylphenol, 4-	UJ	07A			
F88782	AP3086	METALS3-W	Barium	J	12			
F88782	AP3086	METALS3-W	Chromium	J	15			
F88782	AP3086	METALS3-W	Magnesium	J	12			
F88782	AP3086	METALS3-W	Vanadium	J	15			
F88782	AP3086	METALS3-W	Calcium	J	12			
F88782	AP3086	METALS3-W	Zinc	J	15			
F88782	AP3086	METALS3-W	Potassium	J	15			
F88782	AP3086	VOLATILES	Dichloropropene, cis-1,3-	UJ	08A			
F88782	AP3086	VOLATILES	Acetone	UJ	08A			
F88782	AP3086	VOLATILES	Bromoform	UJ	08A			
F88782	AP3086	VOLATILES	Styrene	UJ	08A			
F88782	AP3086	VOLATILES	Dichloropropene, trans-1,3-	UJ	08A			
F88900	AP3083	ALKALINITY	Alkalinity, Carbonate	J	02B			
F88900	AP3083	CHLORIDE	Chloride	J	15			
F88900	AP3083	METALS3-W	Barium	J	15			
F88900	AP3083	METALS3-W	Cobalt	J	15			
F88900	AP3083	METALS3-W	Barium	J	12	15		
F88900	AP3083	METALS3-W	Cobalt	J	15			
F88900	AP3083	METALS3-W	Magnesium	J	12			
F88900	AP3083	METALS3-W	Iron	J	15			
F88900	AP3083	METALS3-W	Calcium	J	12			
F88900	AP3083	METALS3-W	Iron	J	12	15		
F88900	AP3083	METALS3-W	Copper	J	15			
F88900	AP3083	METALS3-W	Potassium	J	15			

Table 4

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

SDG	Sample Number	Analysis	Parameter	VQ	Reason Codes R1	R2	R3	R4
F88900	AP3083	METALS3-W	Potassium	J	15			
F88900	AP3083	SULFATE	Sulfate	J	08A			
F88900	AP3083	TDS	Total dissolved solids	J	17			
F88900	AP3083	VOLATILES	Trichloroethane, 1,1,1-	J	15			
F88900	AP3084	ALKALINITY	Alkalinity, Carbonate	J	02B			
F88900	AP3084	CHLORIDE	Chloride	J	15			
F88900	AP3084	METALS3-W	Barium	J	12	15		
F88900	AP3084	METALS3-W	Cobalt	J	15			
F88900	AP3084	METALS3-W	Barium	J	15			
F88900	AP3084	METALS3-W	Cobalt	J	15			
F88900	AP3084	METALS3-W	Magnesium	J	12			
F88900	AP3084	METALS3-W	Calcium	J	12			
F88900	AP3084	METALS3-W	Iron	J	12	15		
F88900	AP3084	METALS3-W	Iron	J	15			
F88900	AP3084	METALS3-W	Potassium	J	15			
F88900	AP3084	METALS3-W	Potassium	J	15			
F88900	AP3084	NO2/NO3	Nitrate-Nitrite	J	15			
F88900	AP3084	SULFATE	Sulfate	J	08A			
F88900	AP3084	TDS	Total dissolved solids	J	17			
F88900	AP3084	VOLATILES	Trichloroethane, 1,1,1-	J	15			
F88900	AP3087	ALKALINITY	Alkalinity, Carbonate	J	02B			
F88900	AP3087	METALS3-W	Barium	J	12	15		
F88900	AP3087	METALS3-W	Nickel	J	15			
F88900	AP3087	METALS3-W	Aluminum	J	15			
F88900	AP3087	METALS3-W	Barium	J	15			
F88900	AP3087	METALS3-W	Aluminum	J	15			
F88900	AP3087	METALS3-W	Vanadium	J	15			
F88900	AP3087	METALS3-W	Magnesium	J	12			
F88900	AP3087	METALS3-W	Vanadium	J	15			
F88900	AP3087	METALS3-W	Calcium	J	12			
F88900	AP3087	METALS3-W	Iron	UJ	12			
F88900	AP3087	METALS3-W	Zinc	J	15			
F88900	AP3087	METALS3-W	Selenium	J	15			
F88900	AP3087	TSS	Total suspended solids	J	15			
F88900	AP3087	VOLATILES	Acetone	J	15			
F88900	AP3087	VOLATILES	Chloromethane	J	15			
F93578	AP3088	EXPLOSIVES	Nitrotoluene, 2-	J	18	15		
F93578	AP3088	METALS3-W	Aluminum	J	15			
F93578	AP3088	METALS3-W	Barium	J	15			
F93578	AP3088	METALS3-W	Arsenic	J	15			
F93578	AP3088	METALS3-W	Zinc	J	15			
F93578	AP3088	METALS3-W	Potassium	J	15			
F93578	AP3088	VOLATILES	Carbon tetrachloride	UJ	05B			
F93578	AP3088	VOLATILES	Chloromethane	UJ	05B			
F93578	AP3090	METALS3-W	Cobalt	J	15			
F93578	AP3090	METALS3-W	Nickel	J	15			
F93578	AP3090	METALS3-W	Barium	J	15			
F93578	AP3090	METALS3-W	Aluminum	J	15			
F93578	AP3090	METALS3-W	Chromium	J	15			

Table 4

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

SDG	Sample Number	Analysis	Parameter	VQ	Reason Codes R1	R2	R3	R4
F93578	AP3090	METALS3-W	Arsenic	J	15			
F93578	AP3090	METALS3-W	Silver	J	15			
F93578	AP3090	METALS3-W	Potassium	J	15			
F93578	AP3091	METALS3-W	Aluminum	J	15			
F93578	AP3091	METALS3-W	Barium	J	15			
F93578	AP3091	METALS3-W	Cobalt	J	15			
F93578	AP3091	METALS3-W	Arsenic	J	15			
F93578	AP3091	METALS3-W	Zinc	J	15			
F93578	AP3091	METALS3-W	Potassium	J	15			
F93578	AP3091	VOLATILES	Carbon tetrachloride	UJ	05B			
F93578	AP3091	VOLATILES	Methylene chloride	UJ	05B			
F93578	AP3092	METALS3-W	Aluminum	J	15			
F93578	AP3092	METALS3-W	Barium	J	15			
F93578	AP3092	METALS3-W	Cobalt	J	15			
F93578	AP3092	METALS3-W	Zinc	J	15			
F93578	AP3092	METALS3-W	Potassium	J	15			
F93578	AP3092	VOLATILES	Carbon tetrachloride	UJ	05B			
F93578	AP3092	VOLATILES	Methylene chloride	UJ	05B			

Table 5

Laboratory and Validation Qualifier Definitions
Former Plum Brook Ordnance Works
Sandusky, Ohio

Qualifier	Definition
Laboratory	
B (metals)	The analyte was detected; the concentration is below the reporting limit.
B (organics)	Indicates analyte is found in associated method blank.
J (metals)	The compound was detected in the blank.
J (organics)	The compound was positively identified; the reported value is below the reporting limit.
U	Not detected. The compound was analyzed for, but not detected above the associated reporting limit.
E	Indicates that the result is above the maximum calibration range.
N	Indicates presumptive evidence of a compound.
P	RPD > 40% between the primary and confirmation column results for dual column chromatographic method (e.g. GC and HPLC methods).
*	Exceeds QC limit.
Q1	The %D or %Drift for the associated CCV is outside the method QC limit.
ME	Marginal Exceedence of the 3-sigma QC limits.
ME*	Exceedence of the 4-sigma QC limits.
Validation	
B	The compound/analyte was detected in a lab or field blank.
J	The compound/analyte was positively identified; the reported value is an estimated concentration.
U	Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.
UJ	The analyte is not detected; the result is an estimated value.
R	Analyte is rejected.

APPENDIX J

CHAINS OF CUSTODY

F88938

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB 122 11ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 132457 Coal Yards
Required Report Date: 21 DAYS

Sample Shipment Date: 12-21-11
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9869

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884
Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

	Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
1	CY0001	SOIL	12-20-11 / 1100	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082, TOC by Walkley-Black		
2	CY0002	SOIL	12-20-11 / 1115	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
3	CY0004	SOIL	12-20-11 / 1000	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
4	CY0005	SOIL	12-20-11 / 1015	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
5	CY0007	SOIL	12-20-11 / 1155	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
6	CY0008	SOIL	12-20-11 / 1205	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
7	CY0009	SOIL	12-20-11 / 1205	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
8	CY0012	SOIL	12-20-11 / 1242	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
9	CY0013	SOIL	12-20-11 / 1250	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		

Special Instructions:

Possible Hazard Identification:
Non-haz: ___ Flammable: ___ Poison B: ___ Unknown: X

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: E. W. Weaver — Date: 12-21-11 Time: 1600
2. Relinquished by: FX — Date: 12/22/11 Time: 7:30
3. Relinquished by: — Date: Time:

1. Received by: FX — Date: Time:
2. Received by: [signature] ALSE — Date: 12/22/11 Time: 7:30
2. Received by: — Date: Time:

Comments:

3.4c

F 88938

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB[illegible]1221 11ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 132457 Coal Yards
Required Report Date: 21 DAYS

Sample Shipment Date: 12-21-11
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9869

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
9 CY0013 MS	SOIL	12-20-11/1250	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
9 CY0013 MSD	SOIL	12-20-11/1250	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
	SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
	SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
	SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
	SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
	SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
	SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
	SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		

Special Instructions:

Possible Hazard Identification:
Non-haz: ___ Flammable: ___ Poison B: ___ Unknown: X

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X
Project Specific: ___

1. Relinquished by: E. W. Weaver Date: 12-21-11 Time: 1600
2. Relinquished by: Date: Time:
3. Relinquished by: Date: Time:

1. Received by: FX Date: Time:
2. Received by: Fred Jones ALSE Date: 12 22 11 Time: 730
2. Received by: Date: Time:

Comments:

3.4c

F 88938

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB 1221 11ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 132457 Coal Yards
Required Report Date: 21 DAYS

Sample Shipment Date: 12-21-11
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9869

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

	Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
10	CY0003	SOIL	12-20-11/1145	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
11	CY0006	SOIL	12-20-11/1042	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
12	CY0011	SOIL	12-20-11/1225	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
13	CY0014	SOIL	12-20-11/1340	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		

Special Instructions:

Possible Hazard Identification:
Non-haz: ____ Flammable: ____ Poison B: ____ Unknown: X

Sample Disposal:
Return to Client: ____ Disposal by Lab: X Archive: ____

Turnaround Time:
Normal: X Rush: ____

Level of QC Required:
Definitive: X
Project Specific: ____

1. Relinquished by: Eric W. Weaver Date: 12-21-11 Time: 1600
2. Relinquished by: Date: Time:
3. Relinquished by: Date: Time:

1. Received by: FX Date: Time:
2. Received by: Zl Jones ALSE Date: 12/22/11 Time: 730
2. Received by: Date: Time:

Comments:

3.4c

F 88938

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PBOW 1221 11ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 132457 Coal Yards
Required Report Date: 21 DAYS

Sample Shipment Date: 12-21-11
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9869

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

	Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
14	CY0035	SOIL	12-19-11 / 1140	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
15	CY0038	SOIL	12-19-11 / 1330	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
16	CY0041	SOIL	12-19-11 / 1555	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
17	CY0044	SOIL	12-19-11 / 1630	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471		

Special Instructions:

Possible Hazard Identification:
Non-haz: ___ Flammable: ___ Poison B: ___ Unknown: X

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X
Project Specific: ___

1. Relinquished by: E. W. Weaver Date: 12-21-11 Time: 1600
2. Relinquished by: Date: Time:
3. Relinquished by: Date: Time:

1. Received by: FX Date: Time:
2. Received by: [illegible] ALSE Date: 12/22/11 Time: 730
2. Received by: Date: Time:

Comments:

3.4c

F88938

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB[illegible]/1221 11ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 132457 Coal Yards
Required Report Date: 21 DAYS

Sample Shipment Date: 12-21-11
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9869

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

	Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
18	CY0042	SOIL	12-19-11/1600	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
19	CY0043	SOIL	12-19-11/1610	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
		SOIL		2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		

EW

Special Instructions:

Possible Hazard Identification:
Non-haz: ___ Flammable: ___ Poison B: ___ Unknown: X

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: E. W. Weaver Date: 12-21-11 Time: 1600
2. Relinquished by: Date: Time:
3. Relinquished by: Date: Time:

1. Received by: FX Date: Time:
2. Received by: T. L. Torres ALSE Date: 12/22/11 Time: 730
2. Received by: Date: Time:

Comments:

3.4c

F 88938

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB 1221 11ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 132457 Coal Yards
Required Report Date: 21 DAYS

Sample Shipment Date: 12-21-11
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9869

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

	Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
20	CY0031	SOIL	12-19-11 / 1105	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082, TOC by Walkley-Black		
21	CY0032	SOIL	12-19-11 / 1119	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
22	CY0033	SOIL	12-19-11 / 1119	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
23	CY0036	SOIL	12-19-11 / 1250	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
24	CY0037	SOIL	12-19-11 / 1310	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
25	CY0039	SOIL	12-19-11 / 1540	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
26	CY0040	SOIL	12-19-11 / 1545	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
26	CY0040MS	SOIL	12-19-11 / 1545	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
26	CY0040MSD	SOIL	12-19-11 / 1545	2-Wide Mouth Glass Jar	8 oz	Cool	Explosives by 8330, SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		

Special Instructions:

Possible Hazard Identification:
Non-haz: ____ Flammable: ____ Poison B: ____ Unknown: X

Sample Disposal:
Return to Client: ____ Disposal by Lab: X Archive: ____

Turnaround Time:
Normal: X Rush: ____

Level of QC Required:
Definitive: X
Project Specific: ____

1. Relinquished by: Eddie W. Weaver — Date: 12-21-11 Time: 1600
2. Relinquished by: — Date: Time:
3. Relinquished by: — Date: Time:

1. Received by: FX — Date: Time:
2. Received by: [signature] — Date: 12/22/11 Time: 930
2. Received by: — Date: Time:

Comments:

3.4c

ACCUTEST LABORATORIES SAMPLE RECEIPT CONFIRMATION

ACCUTEST'S JOB NUMBER: F 88938 CLIENT: Shaw PROJECT: PBOW

DATE/TIME RECEIVED: 12/22/11 730 {MM/DD/YY 24:00} NIMBER OF COOLERS RECEIVED: 1

METHOD OF DELIVERY: (FEDEX) UPS ACCUTEST COURIER GREYHOUND DELIVERY OTHER

AIRBILL NUMBERS: 8768 6974 9869

COOLER INFORMATION

- [ ] CUSTODY SEAL NOT PRESENT OR NOT INTACT
- [ ] CHAIN OF CUSTODY NOT RECEIVED (COC)
- [ ] ANALYSIS REQUESTED IS UNCLEAR OR MISSING
- [ ] SAMPLE DATES OR TIMES UNCLEAR OR MISSING
- [ ] TEMPERATURE CRITERIA NOT MET
- [ ] WET ICE PRESENT

TRIP BLANK INFORMATION

- [ ] TRIP BLANK PROVIDED
- [x] TRIP BLANK NOT PROVIDED
- [x] TRIP BLANK NOT ON COC
- [ ] TRIP BLANK INTACT
- [ ] TRIP BLANK NOT INTACT
- [ ] RECEIVED WATER TRIP BLANK
- [ ] RECEIVED SOIL TRIP BLANK

MISC. INFORMATION

NUMBER OF ENCORES ? 25-GRAM_____ 5-GRAM_____

NUMBER OF 5035 FIELD KITS ? _____

NUMBER OF LAB FILTERED METALS ? _____

TEMPERATURE INFORMATION

- [ ] IR THERM ID 1 CORR. FACTOR +0.2
- [ ] OBSERVED TEMPS: 3.2
- [ ] CORRECTED TEMPS: 3.4

SAMPLE INFORMATION

- [ ] SAMPLE LABELS PRESENT ON ALL BOTTLES
- [ ] INCORRECT NUMBER OF CONTAINERS USED
- [ ] SAMPLE RECEIVED IMPROPERLY PRESERVED
- [ ] INSUFFICIENT VOLUME FOR ANALYSIS
- [ ] DATES/TIMES ON COC DO NOT MATCH SAMPLE LABEL
- [ ] ID'S ON COC DO NOT MATCH LABEL
- [ ] VOC VIALS HAVE HEADSPACE (MACRO BUBBLES)
- [ ] BOTTLES RECEIVED BUT ANALYSIS NOT REQUESTED
- [ ] NO BOTTLES RECEIVED FOR ANALYSIS REQUESTED
- [ ] UNCLEAR FILTERING OR COMPOSITING INSTRUCTIONS
- [ ] SAMPLE CONTAINER(S) RECEIVED BROKEN
- [ ] % SOLIDS JAR NOT RECEIVED
- [ ] 5035 FIELD KIT FROZEN WITHIN 48 HOUR'S
- [ ] RESIDUAL CHLORINE PRESENT

{APPICABLE TO EPA 600 SERIES OR NORTH CAROLINA ORGANICS}

SUMMARY OF COMMENTS:

TECHNICIAN SIGNATURE/DATE [signature] 12/22/11 REVIEWER SIGNATURE/DATE [signature] 12-22-11

NF 12/10

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB EW 1221 11TA

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mke Gunderson
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 132457 Coal Yards
Required Report Date: 21 DAYS

Sample Shipment Date: 12-21-11
Laboratory Destination: Test America
Laboratory Contact: Denise Pohl
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8989-5317-7768

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
CY0034	Soil	12-19-11 / 1119	Wide Mouth Glass Jar	1 8 ~~2~~ X ~~4~~ oz EW	Cool	SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
				~~8~~ oz	Cool	Explosives by 8330A		
CY0010	Soil	12-20-11 / 1205	Wide Mouth Glass Jar	1 8 ~~2~~ X ~~4~~ oz EW	Cool	SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
				~~8~~ oz	Cool	Explosives by 8330A		
	Soil		Wide Mouth Glass Jar	2 X 4 oz	Cool	SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
				4 oz	Cool	Explosives by 8330A		
	Soil		Wide Mouth Glass Jar	2 X 4 oz	Cool	SVOC by 8270, TAL Metals by 6010/7471, PCBs by 8082		
				4 oz	Cool	Explosives by 8330A		

EW

Special Instructions:

Possible Hazard Identification:
Non-haz: ____ Flammable: ____ Poison B: ____ Unknown: X

Sample Disposal:
Return to Client: ____ Disposal by Lab: X Archive: ____

Turnaround Time:
Normal: X Rush: ____

Level of QC Required:
Definitive: X Project Specific: ____

1. Relinquished by: E. W. Weaver	Date: 12-21-11 Time: 1600	1. Received by: Mike Gunderson	Date: 12/22/11 Time: 8:30
2. Relinquished by:	Date: Time:	2. Received by:	Date: Time:
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

F88782

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB 1216 11ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: EW
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 119268 - Ash Pit 3
Required Report Date: 21 DAYS

Sample Shipment Date: 12-16-11
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6975-0016

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
(1) AP3086	WATER	12-16-11 / 0942	3 VOA Vial	40ml	HCL	VOCs by 8260		
			2 - Amber	1 L	Cool	Explosives by 8330		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270		
			1 - HDPE	500 mL	HNO3	Total TAL Metals/Hardness by 6010B/7470A		
			1 - HDPE	500 mL	HNO3	Dissolved TAL Metals by 6010B/7470A		
			1 - HDPE	500 mL	H2SO4	Nitrate/Nitrite		
			1 - HDPE	500 mL	NaOH	Cyanide by 9010/9012		
			1 - HDPE	1 L	Cool	Turbidity, Alkalinity, TDS, TSS, Sulfate, Chloride		
	WATER	EW	3 VOA Vial	40ml	HCL	VOCs by 8260		
			2 - Amber	1 L	Cool	Explosives by 8330		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270		
			1 - HDPE	500 mL	HNO3	Total TAL Metals/Hardness by 6010B/7470A		
			1 - HDPE	500 mL	HNO3	Dissolved TAL Metals by 6010B/7470A		
			1 - HDPE	500 mL	H2SO4	Nitrate/Nitrite		
			1 - HDPE	500 mL	NaOH	Cyanide by 9010/9012		
			1 - HDPE	1 L	Cool	Turbidity, Alkalinity, TDS, TSS, Sulfate, Chloride		

Special Instructions:

Possible Hazard Identification:
Non-haz: ___ Flammable: ___ Poison B: ___ Unknown: X

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: Eddie W. Weaver Date: 12-16-11 Time: 1225
2. Relinquished by: FX Date: Time:
3. Relinquished by: Date: Time:

1. Received by: FX Date: Time:
2. Received by: Lorne (ALSE) Date: 12-17-11 Time: 09:30
2. Received by: Date: Time:

Comments:

AR

4.1
4

F88782: Chain of Custody
Page 1 of 2

F93578

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB0~~4~~5 30 12ACCT

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Mike Gunderson
Project No.: 140693 AP3
Required Report Date: 21 DAYS

Sample Shipment Date: 5-30-12
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9880

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
1 AP3089	WATER	5-30-12 0956	~~2-Ambers~~	~~1 L~~	~~Cool~~	~~Explosives by 8330~~ EW		
			~~3-VOA~~	~~40 mL~~	~~HCL~~	~~Volatiles by 8260~~ EW		
			~~2-Ambers~~	~~1 L~~	~~Cool~~	~~SVOCs by 8270~~ EW		
			1-HDPE	500 mL	HNO3	TAL Metals by 6010/7471, Hardness		
			~~1-HDPE~~	~~500 mL~~	~~HNO3~~	~~Filtered TAL Metals by 6010/7471~~ EW		
			~~1-HDPE~~	~~1 L~~	Cool	Turbidity, Alkalinity, Sulfate, Chloride, TDS, TSS	EW	
			~~1-HDPE~~	~~500ml~~	~~NaOH~~	~~Total Cyanide~~ EW		
			~~1-HDPE~~	~~500 mL~~	~~H2SO4~~	~~Nitrate/Nitrite~~ EW		
2 AP3090	WATER	5-30-12 1014	~~2-Ambers~~	~~1 L~~	~~Cool~~	~~Explosives by 8330~~ EW		
			~~3-VOA~~	~~40 mL~~	~~HCL~~	~~Volatiles by 8260~~ EW		
			~~2-Ambers~~	~~1 L~~	~~Cool~~	~~SVOCs by 8270~~ EW		
			1-HDPE	500 mL	HNO3	TAL Metals by 6010/7471, Hardness		
			~~1-HDPE~~	~~500 mL~~	~~HNO3~~	~~Filtered TAL Metals by 6010/7471~~ EW		
			~~1-HDPE~~	~~1 L~~	~~Cool~~	~~Turbidity, Alkalinity, Sulfate, Chloride, TDS, TSS~~ EW		
			~~1-HDPE~~	~~500ml~~	~~NaOH~~	~~Total Cyanide~~ EW		
			~~1-HDPE~~	~~500 mL~~	~~H2SO4~~	Nitrate/Nitrite EW		

Special Instructions:

Possible Hazard Identification:
Non-haz: ____ Flammable: ____ Poison B: ____ Unknown: X

Sample Disposal:
Return to Client: ____ Disposal by Lab: X Archive: ____

Turnaround Time:
Normal: X Rush: ____

Level of QC Required:
Definitive: X Project Specific: ____

1. Relinquished by: E. W. Weaver Date: 5-30-12 Time: 1500
2. Relinquished by: FX Date: 05-31-12 Time: 0700
3. Relinquished by: Date: Time:

1. Received by: FX Date: Time:
2. Received by: [illegible] Date: 05-31-12 Time: 0700
2. Received by: Date: Time:

Comments:

3.2

4.1

4

F93578: Chain of Custody
Page 1 of 4

F93578

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB0~~4~~ 5 30 12ACCT EW

PAGE 1 OF 1

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Mike Gunderson
Project No.: 140693 AP3
Required Report Date: 21 DAYS

Sample Shipment Date: 5-30-12
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9880

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
3 AP3088	WATER	5-30-12 1055	1 ~~1~~ Ambers	1 L	Cool	Explosives by 8330		
			2 ~~1~~ VOA EW	40 mL	HCL	Volatiles by 8260		
			~~2 Ambers~~	~~1 L~~	~~Cool~~	~~SVOCs by 8270~~ EW		
			1-HDPE	500 mL	HNO3	TAL Metals by 6010/7471, Hardness		
			~~1-HDPE~~	~~500 mL~~	~~HNO3~~	~~Filtered TAL Metals by 6010/7471~~ EW		
			~~1-HDPE~~	~~1 L~~	~~Cool~~	~~Turbidity, Alkalinity, Sulfate, Chloride, TDS, TSS~~ EW		
			~~1-HDPE~~	~~500ml~~	~~NaOH~~	~~Total Cyanide~~ EW		
			~~1-HDPE~~	~~500 mL~~	~~H2SO4~~	~~Nitrate/Nitrite~~ EW		
4 AP3091	WATER	5-30-12 1105	1 ~~1~~ Ambers	1 L	Cool	Explosives by 8330		
			2 EW ~~1~~ VOA	40 mL	HCL	Volatiles by 8260		
			~~2 Ambers~~	~~1 L~~	~~Cool~~	~~SVOCs by 8270~~ EW		
			1-HDPE	500 mL	HNO3	TAL Metals by 6010/7471, Hardness		
			~~1-HDPE~~	~~500 mL~~	~~HNO3~~	~~Filtered TAL Metals by 6010/7471~~ EW		
			~~1-HDPE~~	~~1 L~~	~~Cool~~	~~Turbidity, Alkalinity, Sulfate, Chloride, TDS, TSS~~ EW		
			~~1-HDPE~~	~~500ml~~	~~NaOH~~	~~Total Cyanide~~ EW		
			~~1-HDPE~~	~~500 mL~~	~~H2SO4~~	~~Nitrate/Nitrite~~ EW		

Special Instructions:

Possible Hazard Identification:
Non-haz: ____ Flammable: ____ Poison B: ____ Unknown: X

Sample Disposal:
Return to Client: ____ Disposal by Lab: X Archive: ____

Turnaround Time:
Normal: X Rush: ____

Level of QC Required:
Definitive: X Project Specific: ____

1. Relinquished by: Eric W. Weaver Date: 5-30-12 Time: 1500
2. Relinquished by: FX Date: 05-31-12 Time: 0700
3. Relinquished by: Date: Time:

1. Received by: FX Date: Time:
2. Received by: R. Williams Date: 05-31-12 Time: 0700
2. Received by: Date: Time:

Comments:

3.2

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F93578: Chain of Custody
Page 2 of 4

F93578

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB0~~1~~5 30 12ACCT
EW

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: Mike Gunderson
Profit Center: Knoxville
Project Manager: Mike Gunderson
Project No.: 140693 AP3
Required Report Date: 21 DAYS

Sample Shipment Date: 5-30-12
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8768-6974-9880

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884
Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
5 AP3092	WATER	5-30-12 1115	1 ~~2~~ Ambers	1 L	Cool	Explosives by 8330		
			2 ~~3~~ 5-VOA	40 mL	HCL	Volatiles by 8260		
			~~2 Ambers~~	~~1 L~~	~~Cool~~	~~SVOCs by 8270~~ EW		
			1-HDPE	500 mL	HNO3	TAL Metals by 6010/7471, Hardness		
			~~1 HDPE~~	~~500 mL~~	~~HNO3~~	~~Filtered TAL Metals by 6010/7471~~ EW		
			~~1 HDPE~~	~~1 L~~	~~Cool~~	~~Turbidity, Alkalinity, Sulfate, Chloride, TDS, TSS~~ EW		
			~~1 HDPE~~	~~500ml~~	~~NaOH~~	~~Total Cyanide~~ EW		
			~~1 HDPE~~	~~500 mL~~	~~H2SO4~~	~~Nitrate/Nitrite~~ EW		
6 Trip Blank	WATER	By Lab	~~2 Ambers~~	~~1 L~~	~~Cool~~	~~Explosives by 8330~~ EW		
			2 ~~3~~ 5-VOA	40 mL	HCL	Volatiles by 8260		
			~~2 Ambers~~	~~1 L~~	~~Cool~~	~~SVOCs by 8270~~ EW		
			~~1 HDPE~~	~~500 mL~~	~~HNO3~~	~~TAL Metals by 6010/7471, Hardness~~ EW		
			~~1 HDPE~~	~~500 ml~~	~~HNO3~~	~~Filtered TAL Metals by 6010/7471~~ EW		
			~~1 HDPE~~	~~1 L~~	Cool	Turbidity, Alkalinity, Sulfate, Chloride, TDS, TSS EW		
			~~1 HDPE~~	~~500ml~~	~~NaOH~~	~~Total Cyanide~~ EW		
			~~1 HDPE~~	~~500 mL~~	~~H2SO4~~	~~Nitrate/Nitrite~~ EW		

Special Instructions:

Possible Hazard Identification:
Non-haz: ____ Flammable: ____ Poison B: ____ Unknown: X

Sample Disposal:
Return to Client: ____ Disposal by Lab: X Archive: ____

Turnaround Time:
Normal: X Rush: ____

Level of QC Required:
Definitive: X Project Specific: ____

1. Relinquished by: E. W. Weaver	Date: 5-30-12 Time: 1500	1. Received by: FY	Date: Time:
2. Relinquished by: FY	Date: 05-31-12 Time: 0700	2. Received by: [illegible]	Date: 05-31-12 Time: 0700
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

3.2

4.1
4

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ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB 1220 11TA

PAGE 1 OF 1

Bill To: Attn: Accounts Payable Dept.
Shaw Environmental
P.O. Box 98519
Baton Rouge, LA 70884

Report To: Eddie Weaver
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Project Name/No: PBOW
Sample Team Member: EW
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 119268 - Ash Pit 3
Required Report Date: 21 DAYS

Sample Shipment Date: 12-20-11
Laboratory Destination: Test America
Laboratory Contact: Denise Pohl
Project Contact/Phone: Eddie Weaver/865-690-3211
Carrier Waybill No.: 8989-5317-7713

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
AP3085	WATER	12-19-11 1110	2 - Amber	1 L	Cool	Explosives by 8330		
			1 - HDPE	1 L	HNO3	Total TAL Metals by 6010B/7470A		
			1 - HDPE	1 L	HNO3	Dissolved TAL Metals by 6010B/7470A		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - VOA Vial	40 mL	HCL	VOCs by 8260		
			1 - HDPE	250 mL	NaOH	Cyanide by 9010/9012		
			1 - HDPE	1 L	Cool	Turbidity, Alkalinity, TDS, TSS, Sulfate, Chloride		
			1 - HDPE	250 mL	HNO3	Nitrate/Nitrite		
			1 - HDPE	250 mL	HNO3	Hardness		

EW

Special Instructions:

Possible Hazard Identification:

Non-haz: ____ Flammable: ____ Poison B: ____ Unknown: X

Sample Disposal:

Return to Client: ____ Disposal by Lab: X Archive: ____

Turnaround Time:

Normal: X Rush: ____

Level of QC Required:

Definitive: X Project Specific: ____

1. Relinquished by: Eddie W. Weaver	Date: 12-20-11 Time: 1600	1. Received by: Mike Hanlon	Date: 12/21/11 Time: 8:30
2. Relinquished by:	Date: Time:	2. Received by:	Date: Time:
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

APPENDIX K

BALD EAGLE MONITORING

Shaw Environmental & Infrastructure, Inc.

Shaw The Shaw Group Inc.™

312 Directors Drive
Knoxville, TN 37923
865.690.3211
Fax: 865.694.7497

Memorandum

Date: **May 7, 2012**

To: **Plum Brook Project Team Members**

CC: **Lannae Long, USACE – Nashville**

From: **Jon Lindberg**

RE: **Summary of Bald Eagle Monitoring at Active Nest near Ash Pit 3 Groundwater Wells**

This memorandum summarizes the monitoring of an active bald eagle nest near the southern edge of Ash Pit 3 during groundwater sampling activities performed at several wells at the Ash Pit 3 site on April 24, 2012. The protocol for sampling the wells while minimizing disturbance to the eagles was described in the Memorandum *Protocol for Groundwater Sampling Near the Active Bald Eagle Nest at Ash Pit 3, Plum Brook Ordnance Works, Sandusky, Ohio*, dated April 20. One exception to the protocol was made; rather than a single Sampler, the bulky nature of the snap samplers necessitated that a second Sampler be used to handle and deploy the snap samplers and assist with the collection of water levels.

Prior to arriving at Ash Pit 3, a snap sampler was installed at an Ash Pit 1 well (AP1-MW01). The purpose of installing this snap sampler was two-fold; first, it allowed the sampling team to familiarize themselves with the deployment of the snap samplers so that deployment would be more efficient at the Ash Pit 3 wells, and second, data from the snap samplers will be compared with data collected using traditional "purge and pump" collection method.

Following the deployment of the snap sampler at AP1-MW01, Ash Pit 3 was accessed via Maintenance Road. Vehicles were parked in the parking lot located to the northeast of the former Waste Water Treatment Plant 3, approximately 950 feet north of the bald eagle nest. The Observer (Jon Lindberg, Shaw) positioned himself approximately 150 feet west of Ransom Road, north of the former power house building, approximately 850 feet from the nest. The two Samplers accessed monitoring wells AP3-MW03 (approximately 505 feet from the nest), -MW02 (approximately 450 feet from the nest), and –MW01 (approximately 480 feet from the nest) between the time of arrival at 11:00 a.m., and departure time of 12:05 p.m. During this period, both adult eagles were observed at or near the nest. No eaglets were observed at any time, although site personnel had witnessed at least one juvenile in the nest on previous occasions. A log of the observed eagle activity and

behavior during the sampling was kept and is presented below. Observations were made at 5 minute intervals, as well as when the Samplers entered or exited the site, and when any change in eagle behavior was observed.

Arrival: 11:00 am
Conditions: 60 degrees Fahrenheit, strong breeze from the north (approximately 20-25 miles per hour), sunny.

Time	Notes
1105	One adult eagle perched approximately 30 feet east of nest, other adult not observed. Shortly after arrival, observed eagle flew and circled around northern edge of tree stand surrounding Ash Pit 3 towards the vehicles parked near former Waste Water Treatment Plant 3, then circled to the west, and flew out of sight.
1107	Samplers entered from north to sample first well (AP3-MW03)
1110	No sign of eagles
1115	No sign of eagles
1116	Samplers return to truck. No sign of eagles
1119	Adult eagle observed perching approximately 30 feet from nest. Adult was looking in direction of Observer, and vocalizing.
1120	Samplers begin walking to sample second well (AP3-MW02). No change in eagle position.
1123	Both eagles (the one being observed, and the other adult, previously out of view) flush when Samplers approach AP3-MW02.
1125	One adult eagle observed circling overhead. Other adult eagle not seen.
1127	Sampling crew exits. Circling adult eagle out of view. Second adult heard vocalizing in trees near Ash Pit 3, but not seen.
1130	No eagles observed. Vocalizations from treed area continue.
1133	Adult eagle observed perching on edge of nest.
1135	Adult eagle observed perching on edge of nest.
1138	Sampler approaches Observer. Adult eagle observed perching on nest. Vocalizations heard.
1140	Samplers leave in a vehicle to get camera at the Shaw trailer. No change in eagle behavior.
1145	Adult eagle observed perching on nest. Vocalizations heard.
1146	Samplers return with camera. No change in eagle behavior.
1150	Samplers enter sample area to deploy sample in AP3-MW01. Adult still on nest, no vocalizations heard.
1155	Samplers still at AP3-MW01. Adult still on nest, no vocalizations heard.
1200	Samplers still at AP3-MW01. Adult still on nest, no vocalizations heard.
1201	Samplers exit. Adult still on nest, no vocalizations heard.
1205	Demobilization from site.

The adult eagles exhibited some stress behavior during the Ash Pit 3 sampling event, including vocalizations and movement off of/away from the nest. However, the only time both adults were flushed from the area was when AP3-MW02 was sampled, which is the well closest to the eagle nest. However, within 10 minutes one adult had returned to the nest, and the other was heard vocalizing nearby. Deployment of the snap samplers appeared to only minimally disturb the nesting eagles, and no impacts to their nesting activities or the successful fledging of the eaglet(s) are anticipated.

Shaw Environmental & Infrastructure, Inc.

The Shaw Group Inc.™

312 Directors Drive
Knoxville, TN 37923
865.690.3211
Fax: 865.694.7497

Memorandum

Date: **June 6, 2012**

To: **Plum Brook Project Team Members**

CC: **Lannae Long, USACE – Nashville**

From: **Jon Lindberg**

RE: **Summary of Bald Eagle Monitoring During Ash Pit 3 Snap Sample Retrieval on May 30, 2012**

This memorandum summarizes the monitoring of an active bald eagle nest near the southern edge of Ash Pit 3 at Plum Brook Ordnance Works on May 30, 2012. The monitoring was performed to record eagle behavior during the retrieval of three snap samplers that had been deployed in groundwater wells AP3-MW01, AP3-MW02, and AP3-MW03 at the Ash Pit 3 site on April 24, 2012. The protocol for sampling the wells while minimizing disturbance to the eagles was described in the Memorandum *Protocol for Groundwater Sampling Near the Active Bald Eagle Nest at Ash Pit 3, Plum Brook Ordnance Works, Sandusky, Ohio*, dated April 20, 2012. As was the case when the snap samplers were deployed, one exception to the protocol was made; the bulky nature of the snap samplers necessitated that two individuals (rather than one, as recommended in the protocol) were needed to retrieve the snap samplers and assist with the collection of water levels.

A snap sampler had also been deployed at an Ash Pit 1 well (AP1-MW01) as a test case. Prior to retrieving the snap samplers at Ash Pit 3, the Ash Pit 1 snap sampler was retrieved in order to familiarize the sampling team with how to operate the sampler closing mechanism, retrieve the sampler from the bore hole, and process the samples in the least amount of time thereby minimizing the level of noise. A traditional "purge and pump" sample was also collected at the Ash Pit 1 monitoring well to compare to the data obtained from the snap sampler. The samples from well AP1-MW01 were to be analyzed for metals only.

Following the retrieval of the snap sampler at AP1-MW01, Ash Pit 3 was accessed via Maintenance Road. Vehicles were parked in the parking lot located to the northeast of the former Waste Water Treatment Plant 3, approximately 950 feet north of the bald eagle nest. The sampling team consisted of three individuals: Mr. Jon Lindberg ("Observer", Shaw), Mr. Mike Gunderson ("Sampler" 1, Shaw), and Mr. Joe Baltz ("Sampler 2", Shaw). **Figure 1** provides an overview of the site and the locations of the eagle nest, monitoring wells,

Observer location, and other details. Also presented on this figure are the boundaries of three protection zones for bald eagle nests as described in the *Protected Species Management Strategy For NASA Glenn Research Center at Lewis Field and Plum Brook Station* (SAIC, 2002). Recommendations presented in this document for these zones during the nesting season (February 1 through July 15) are summarized as follows:

- Zone 1 (0 to 330 feet from nest): Area in which eagles are most sensitive to disturbance, and the greatest degree of protection is necessary. Unauthorized people should not be allowed in this zone. Foot traffic kept to an absolute minimum.
- Zone 2 (331 to 660 feet from nest): Eagles still sensitive to disturbance in this zone during the nesting season. Human activity should be kept to a minimum.
- Zone 3 (661 to 1220 feet from nest): Most activities are possible in this zone. However, activities that are within sight of the eagles on the nest may need to be conducted outside the breeding season.

The Observer positioned himself approximately 150 feet west of Ransom Road, north of the former power house building, approximately 750 feet from the nest. The two Samplers accessed monitoring wells AP3–MW01 (approximately 480 feet from the nest), -MW02 (approximately 450 feet from the nest), and -MW03 (approximately 505 feet from the nest) between the time of arrival at 10:40 a.m., and departure time of 11:35 a.m. Both adult eagles were observed near the nest at the time of arrival. No juveniles were initially in sight, but a juvenile eagle that appeared to be nearly full grown was observed perched near the edge of the nest from Ransom Road immediately after the snap sampling retrieval activities were completed. Site personnel reported that a second juvenile had been observed at the nest as well (personal communication with Rosemary Walker, SAIC). A log of the observed eagle activity and behavior during the sampling was recorded during the retrieval of the snap samplers at the three Ash Pit 3 wells, and is presented below. Observations were made at 5 minute intervals, as well as when the Samplers entered or exited the site, and when any change in eagle behavior was observed. At each well, Sampler 2 retrieved the snap sample, and Sampler 1 collected water levels using a water level meter. Although the water level meter makes a beeping sound when the probe encounters water, the volume level was reduced to its minimum setting while sampling the Ash Pit 3 wells.

As noted in the log (provided below), the adult eagles exhibited some stress behavior during the Ash Pit 3 sampling event, including leaving the nest and flying over the vehicles parked in the staging area, and possible vocalizations during the retrieval of the snap samplers. Although the eagles were not seen during much of the sample retrieval time period, at least one adult was apparently near the nest for part of or most of the time, as it was observed flying towards the parked vehicles after the retrieval of the AP3-MW02 sampler (see 1113 entry).

It is noted that the presence of at least one juvenile at the nest provides confirmation that the snap sampler deployment in April did not adversely impact the nesting success of the eagles. Because the April deployment activities not only took longer (approximately one hour, compared with less than an hour for retrieval) but also were performed during a more sensitive time frame of the nesting period (i.e., when the juveniles were smaller, and required more care and protection from predators), it can be assumed that the retrieval activities had little impact on eagle nesting success as well. Snap sampler retrieval appeared

to only minimally disturb the nesting eagles, and no impacts to their nesting activities or the successful fledging of the juvenile eagle(s) are anticipated.

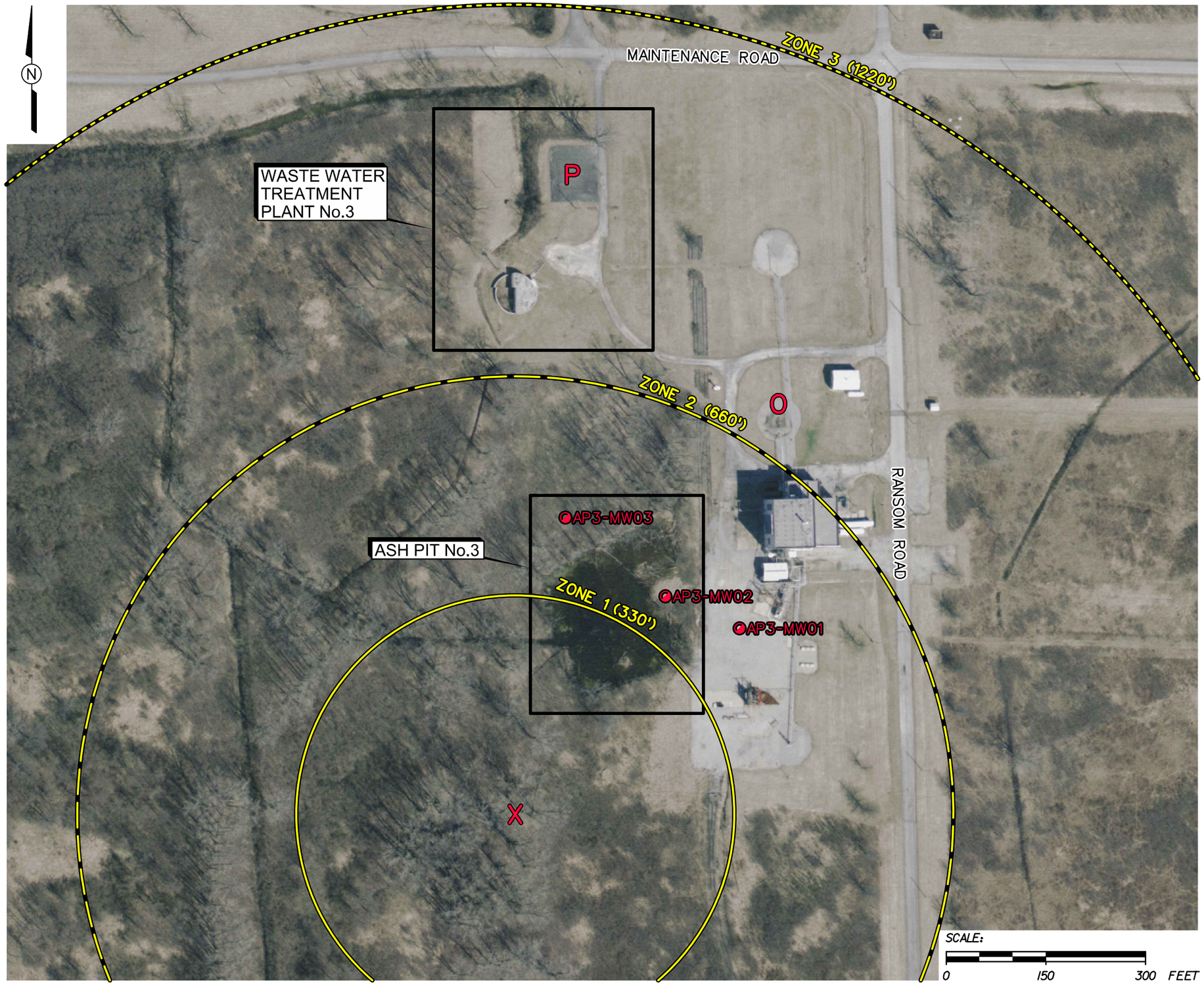
Eagle Observation Log during Snap Sampler Retrieval, Ash Pit 3

Date: May 30, 2012
Arrival: 10:40 am
Conditions: 75 degrees Fahrenheit, light breeze (approximately 5 miles per hour from the west), full sun, leaf cover in trees near eagle nest much denser than during the April snap sampler deployment.

Time	Notes
1040	One adult eagle perched near nest. Shortly after arrival, the second adult flew in to the nest area carrying a fish, and then was lost from view. Shortly afterwards, both adults flew towards the vehicles parked near former Waste Water Treatment Plant 3, and circled overhead until sample retrieval activities began.
1050	Begin observation, Observer in position. Eagle nest obscured from view due to leaves (nest was visible from the same position during the April sampler deployment).
1052	Samplers entered from north to retrieve sample from first well (AP3-MW01). No sign of eagles (eagles out of view, and no vocalizations heard).
1055	No sign of eagles.
1058	No sign of eagles. Sampler 1 returned to vehicles with snap sampler.
1100	No sign of eagles. Sampler 2 moved to we1l AP3-MW02.
1105	No sign of eagles. Sampler 1 re-enters site and headed to well AP3-MW02.
1110	No sign of eagles. Samplers 1 and 2 returned to truck with snap sampler from well AP3-MW02.
1113	One adult eagle observed flying from nest area towards parked vehicles, then turned and flew out of view to the northwest. Other adult eagle not seen.
1115	Sampler 1 entered the site to access well AP3-MW03. No sign of eagles.
1116	No eagles observed. However, possible vocalizations from the treed area near MW03 are noted. (After sampling, Samplers 1 and 2 said they did not notice any eagle noises while retrieving the MW03 sampler.)
1118	Samplers 1 and 2 returned to the vehicle area with snap sampler. No sign of eagles.
1120	No sign of eagles.
1123	No sign of eagles. Observer returns to vehicle area.
*1139	After mobilizing from the AP3 site, the eagle nest was in view while driving south on Ransom Road to the east of Ash Pit 3. After stopping the vehicle, the nest was scanned with binoculars and a juvenile was observed perching near the edge of the nest. Observation lasted approximately 5 minutes, during which there was no sign of the adults or the other (reported) juvenile. **post-sample retrieval*

References

Science Applications International Corporation (SAIC), 2002, ***Protected Species Management Strategy for NASA Glenn Research Center at Lewis Field and Plum Brook Station, Volume III: Management Plan***, Final, May 10.



LEGEND:

- AREA OF CONCERN
- OVERBURDEN/SHALE MONITORING WELL
- P PARKING AREA
- O OBSERVER LOCATION
- X BALD EAGLE NEST

EAGLE PROTECTION ZONES:

- ZONE 1 (330')
- ZONE 2 (660')
- ZONE 3 (1220')

FIGURE 1
GROUNDWATER MONITORING WELL SAMPLING NEAR BALD EAGLE NEST AT ASH PIT No.3

TECHNICAL MEMORANDUM

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

CBI

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APPENDIX L

RESPONSE TO COMMENTS

Response to Comments - OEPA
Draft Ash Pit No. 1 and Ash Pit No. 3
Site Characterization Report Addendum
For Coal Yard No. 3 Soil and Ash Pit No. 3 Groundwater
Former Plum Brook Ordnance Works, Sandusky, Ohio
(Report dated October 2012)

Reference: Comments from Dr. Janusz Z. Byczkowski, DERR, CO, email dated December 14, 2012.

Comment 1: **Section 4.2.2, Page 4-4, Line #20; This document states:** ***"…This PBOW team agreement, which has been used for all PBOW risk assessment to date, take precedence over the subsequent OEPA (2009) guidance. This protocol ensures that all PBOW sites will be evaluated for background in a consistent manner …"***

<u>Comment:</u>
The issue of determining background and the "agreement" was already discussed in previous reviews. Please note that no legally binding agreement has been made with the USACE or Shaw Environmental Inc., regarding risk assessment at the NASA Plum Brook Site.

Please also note that due to heterogeneity of geological formations across the vast area of PBOW, no single set of background levels should be applied in order to evaluate different areas of concern or different media horizons.

Recommendation:
Please provide appropriate justification for not applying the recommended OEPA-DERR (2009) methodology.

Response 1: The background soil data set was selected to include the common interbedded sands, silts, and clays encountered throughout the PBOW facility. OEPA Project Delivery Team members provided input for the potential sampling locations and sample selection for these background data sets, which are described in the referenced documents. The last statement in the referenced paragraph provides the justification for using the background screening concentrations as points of reference in this document: " *This protocol ensures that all PBOW sites will be evaluated for background in a consistent manner*."

Comment 2: **Section 5.1.2, Page 5-2, Line #6; This document states:** ***"…Surface soil samples were collected at depths of 0.2 to 1.2 feet bgs […], 1.5 to 2.5 feet bgs […], and 0 to 1 foot bgs …"***
And in Sect. 5.2.1:
"…surface soil in the upper 16 feet were…"

<u>Comment:</u>

The definition of surface and subsurface soil requires some site-specific justification, as the U.S. EPA (1996), considers sampling, e.g., for urban soil Pb abatement, only the upper 2 or 3 cm as a "*surface soil*".

Reference:
U.S. EPA (1996) Soil Screening Guidance: User's Guide. Publication 9355.4-23, July 1996; Attachment B: Soil Screening DQOs for Surface Soils and Subsurface Soils:

Recommendation:
Please explain and justify site- and exposure scenario-specific definitions of "surface soil".

Response 2: Surface soil at PBOW is considered to be soil collected from a depth of 0 to 1 foot below ground surface (bgs), provided that the material at this interval is representative of the true native soil which would have been present during PBOW operations (Shaw, 2011). This surface interval may be adjusted downward if fill material is encountered during drilling. Sand and other fill material has been encountered at various PBOW areas, which was used to level the ground surface and cover foundations. The intervals of samples SB-01 (0.2 to 1.2 feet bgs) and SB-02 (1.5 to 2.5 feet bgs) were adjusted, so that soil samples are collected below the fill material in these borings. The other two surface soil samples were collected at 0 to 1 foot bgs, because no fill was encountered.

A surface soil interval of 0 to 1 foot is standard for environmental sampling at many hazardous waste sites (e.g., EPA, 2000), including PBOW. Please note that the 0 to 1-foot interval is included in the PBOW work plans approved to date. This depth interval is appropriate for facilities such as PBOW where contamination may have occurred decades ago and would be expected to have migrated beyond the upper 2-3 centimeters (0.1 foot) of soil. Additionally, it is likely that soil in the upper 0.1 foot is not representative of soils present in the 1940's because of deposition from the air and the production of organic materials associated with plant growth.

References:
Shaw Environmental, Inc. (Shaw), 2011, ***Final, Site-Specific Sampling and Analysis Plan, Investigation of Coal Yards in the Areas of Ash Pit Nos. 1 & 3 and Powerhouse No. 2 Ash Pit, Former Plum Brook Ordnance Works, Sandusky, Ohio,*** December.

U.S. Environmental Protection Agency, 2000, ***Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment Bulletins***. Region 4, Atlanta, Georgia, May.